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## CENTRAL ROAD RESEARCH INSTITUTE, DELHI

THE Central Road Research Institute, Delhi, the eighth in India's chain of National Laboratories, was formally declared open by Shri Pandit Jawaharlal Nehru, Prime Minister of India, on July 16th.

While the need for a Road Research Institute has been felt for some considerable time, the proposal to establish one is only of recent origin. The Conference of Chief Engineers of Provinces and States held at Nagpur in December 1943, proposed that India should have an additional 4 lakh miles of roads,\* including approximately 25,000 miles of national highways, 65,000 miles of provincial highways, 1,00,000 miles of major district roads and 1,50,000 miles of village roads. It was felt that if as a result of research, it is possible to reduce the cost of construction and maintenance by even one per cent. it will mean a saving in crores of rupees.

The above proposal for a Road Research Institute took definite shape a year later when, at the initiative of Dr. S. S. Bhatnagar, then Director, Scientific and Industrial Research, and Mr. G. M. McKelvie, Consulting Engineer to the Government of India (Roads), the Industrial Research Planning Committee of the Council of Scientific and Industrial Research, recommended the establishment of a Central Research Institute covering all aspects of road research, such as building, equipment, maintenance, traffic and use. The Governing Body of the Council accepted this recommendation in 1945 and constituted a Road Research Planning and Advisory Committee for drawing up plans for the Research Institute. The Committee recommended that the Institute should be located at a place easily accessible to scientists and highway engineers from all parts of the country and that it should be near the Roads Organisation of the Ministry of Transport. These considerations led to the location of the Institute at Delhi, and a suitable site at the 7th mile of the Delhi-Mathura Road, about 31 acres in area, was secured as a gift from His Grace the Archbishop of Delhi-Simla. The site is advantageous since the Delhi-Mathura Road

\* The total length of roads in India to-day is 3·5 lakh miles. The cost of constructing bituminous roads is about Rs. 30,000 per mile of road ten feet wide and Rs. 50,000 for a cement concrete road. A kutch road costs more than Rs. 5,000 a mile, besides heavy cost of maintenance.

carries a heavy traffic, which can be diverted over the Institute's test tracks for experimental purposes. The foundation-stone of the Institute was laid by the Hon'ble Shri N. Gopalaswamy Iyer, the then Minister for Transport, Government of India, on September 6, 1950, and the construction of the Institute buildings commenced in February, 1951. Research work started concurrently in a temporary laboratory building constructed mostly from American pre-fabricated wood work.

The functions of the Central Road Research Institute are: fundamental research on the behaviour of materials used in road construction; correlation of test results on standard materials with those under practical conditions for enabling reliable estimates to be formed of the behaviour of road materials; tests on soils and study of soil mechanics; research connected with standards and specifications for roads and road-building plant machinery; design of instruments for road tests; studies on road characteristics under different conditions, incidence of accidents, road safety devices and road statistics; collaborative research projects with engineering colleges, research institutes and industrial concerns; technical advice and assistance; dissemination of results of road research by pamphlets, films, etc., for the benefit of road engineers and training of road technologists.

Special emphasis will be laid on low-cost, all-weather rural roads and their construction from locally available material. Test tracks will be laid in various parts of India and the results obtained in the Central Institute will be checked under service conditions prevailing in various localities.

The work of the Institute is to be organised under the following divisions: (1) Soils, (2) Flexible Pavements (Bituminous Materials), (3) Rigid Pavements (Mineral Materials), (4) Road, and (5) Traffic Engineering and Economic Research. Other sections of the Institute are: Workshop, Museum, Library and Intelligence, Photography and Drawing, Publications, Administration, Purchases and Stores.

Efficiency has been a primary consideration governing the design and layout of the Institute and architectural features have received due consideration. The total capital cost of the buildings, fittings and equipment is estimated at Rs. 29·64 lakhs. A sum of Rs. 19 lakhs has been spent on equipment and construction work so far.

Equipped on a scale which we have learnt to associate with the present Government of India, we indeed hope and trust that the new Institute would also contribute its legitimate share in furthering the progress and prosperity of our country.

#### DON TO VOLGA

THE meeting of the waters of the Volga and the Don, through the newly-completed canal that links the two great rivers, fulfils an ancient dream of the Russian people. Over sixty miles long, the canal joins the river systems of the Black Sea Basin with the navigable rivers of the Volga and north-west basins, and links the White, Baltic and Caspian Seas with the Sea of Azov and the Black Sea.

The construction of the Tsimlyansk dam is a particularly fine piece of engineering achievement. Huge dams which are subjected to the pressure of an enormous mass of water are usually founded on rock. At Tsimlyansk, however, the dam raising the level of the Don to a height of over 85 feet and capable during the spring floods of letting through up to 4½ mil-

lion gallons of water per second had to be built on fine sand. Scientists and engineers boldly tackled this difficult task for the first time and solved it in a brilliant manner. Using enormous and intricate devices, special extinguishers, scoops, etc., the speed of the water has been cut down to a twenty-fifth, thus making it absolutely safe even for sand. To safeguard the dam from sub-soil waters, steel piles were driven into the ground by vibration.

The Volga Don construction which includes a ship canal, an electric power station and a huge irrigation system was completed in less than three years while the greater part of the work has been put through during the last twelve months.

## THE CLASSIFICATION OF MAN

CEDRIC DOVER

CLASSIFICATIONS of human groups have an increasing social significance. Nevertheless, they continue to be affected by irregularities of interpretation and method, the latter being the subject of this note. Its shape has responded to consultations with Dr. S. L. Hora, Mr. A. Fraser Brunner and Mr. W. H. T. Tams, all of whom have particular experience in the fields from which apparent sanctions for confusing practices are sometimes drawn. I am also grateful to Dr. Kenneth Oakley for helpful discussion.

It would appear, to begin with, that the promotion of a useful classificatory science of man depends on the resolution of two seemingly different conceptions. The first assumes that it belongs to zoological taxonomy, the second that it is a matter for a special typology; and both views are complicated by a tendency amongst certain anthropologists to branch out into uncontrolled procedural directions. Annandale, observing this inclination more than thirty years ago,<sup>1</sup> warned those concerned that "Anthropology is fundamentally a branch of biology....perhaps the most complicated of all the branches of biology. To me it is inconceivable that a sound knowledge of anthropology can be obtained without a preliminary training in biological method." A few years later, Wood Jones<sup>2</sup> was still more precise: "The anthropologist should be a mammalogist who happens to be dealing with a particular mammalian type; and he should co-ordinate his procedure and weigh his hypotheses by the standards employed by workers in other mammalian groups."

But participation has become so characteristic a feature of Western science in our generation that, in 1945, Simpson could justifiably complain<sup>3</sup> that "much of the work on primates has been done by students who had no experience in taxonomy and who were completely incompetent to enter the field." Moreover, he felt that "many studies of this order are covertly or overtly emotional"; and that it would perhaps "be better for the zoological taxonomist to set apart the family Hominiidae and to exclude its nomenclature and classification from his studies." The alternative, especially for zoologists who recognise the rôle of their own neglect in the situation deplored by Dr. Simpson, is to struggle with the confusions of Hominiid taxonomy, even though they become somewhat overwhelming when "racial" classifica-

tions are reached. The magnitude of this task is indicated by the following passage<sup>4</sup> from Trevor's recent abridgement on "race" in a standard work:

"Zoologically race is often equated with subspecies, although there is a tendency amongst some systematists to regard it as a more restricted category for intergrading populations of mammals and fishes. Most anthropologists would agree that all human beings who have lived during the past 10,000 years at least have belonged to a single but polymorphic<sup>5</sup> species—and most again in endeavouring to distinguish the various forms of this have considered, explicitly or otherwise, a hierarchy embracing three grades of different degrees of inclusiveness. The first and widest may be thought of as a constellation of races and has been designated 'variety', 'sub-species', 'primary group', 'major group', 'trunk', etc. The second and more restricted is in general termed simply 'race' and the third and narrowest 'sub-race'."

Dr. Trevor's own involvement in this peculiarly intricate synthesis is expressed<sup>6</sup> elsewhere in the comment that he is "in sympathy with some recent mammalogists, ornithologists and ichthyologists in regarding 'race' as a lesser category than sub-species or variety, a practice which Hubbs feels will come to be widely adopted in vertebrate zoology." Dr. Trevor has also said at meetings of the Royal Anthropological Institute and UNESCO that "variety" can be regarded as a higher category than subspecies.

Such taxonomic heresies could be abundantly elaborated from still more authoritative sources: it was not so long ago, for example, that a renowned anthropologist created the family *Homo-simiidae* for the reception of *Australopithecus*. But, since they concern the concept of subspecies, it might be more useful to indicate the nature of its applications in zoological taxonomy. Its employment was first clarified as follows by Rothschild and Jordan<sup>7</sup> in their classic "Revision of the Sphingidae":

"Since Linné applied the term *varietas* to the forms which are not specifically different, we do not see any reason against the use of this very convenient word in the same sense for all the components of a species which differ from one another. We understand, therefore, under *variety* not a particular category of the components of a species, but employ the term for all the different members of a species indiscriminately. The different categories of varieties must receive special terms in a precise classification, and special formulae must be employed for them in a precise nomenclature."

In accordance with this logic, they distinguished three kinds of varieties—individual, generatory and geographical—of which the *geographical variety* or *sub-species* “is the highest category of varieties.” They added that:

“As the term *varietas* includes also other varieties, it cannot be employed as such for the geographical variety except in a precise nomenclature; either a specifying attribute must be added (*var. geog.*), or an abbreviation of another term chosen (*subsp.*). But...we can do without the abbreviation...by simply mutually agreeing that a sub-species is designated by its name added to that of the species without any abbreviation before the sub-specific name.”

This formulation subsidised the growth of the trinomial system and its regulation by the International Commission on Zoological Nomenclature;<sup>8</sup> but its acceptance had a deeper basis than that of the authority of the Tring zoologists, or a codified agreement upon a systematic convenience. The environmental thinking influencing it has always been deeply rooted in biological philosophy; communities were regarded as potential species, and subspecies as communities well on the way to specific status. The vigour of this idea, during the years when the binomial system was being transformed, was emphasised by Tate Regan:<sup>9</sup>

“My own work on the structure, classification and geographical distribution of fishes, has led me to certain conclusions. I believe that the first step in the origin of a new species is not a change of structure, but the formation of a community, either through localization, geographical isolation, or habitual segregation.”

This opinion was emphasised by the brilliant researches of Annandale,<sup>10</sup> Hora<sup>11</sup> and others who believed that “evolution is no more than the adaptation of organisms to environment” (Hora); and the advance of genetics has by no means eliminated it.<sup>12</sup> Supporting experimental evidence was also available, which found a new but neglected significance in the remarkable studies of the American Negro cytologist, E. E. Just.<sup>13</sup> He offered the first major proofs for placing “the determination of characters in the cytoplasmic reactions”; and the independent continuation of similar enquiries in Soviet Russia<sup>14</sup> will only be ignored by those whose scientific vision has become clouded by the “cold war”.

Yet the environmental view did no more than create a part of the philosophical atmosphere for the trinomial system and its attendant standards. The functional stimuli came na-

turally from the actual materials under analysis—and not the least of these arose from the morphological phenomenon of isomerism characteristic of animals in general and the higher vertebrates in particular. These repetitions of similar parts narrow down from the supra-specific unities to the species level; and, by confounding structural diagnoses, compel reference to geographic or ecologic criteria. In botany, on the other hand, the task is somewhat simpler. Anisomerism (or marked changes of emphasis on a fundamental pattern) amongst the flowering plants facilitates the morphological separation of nearly related species and infra-specific categories.

It often happens that the extension of a system urges further extensions, but taxonomists have resisted the creation of a quadrinomial nomenclature, partly because it would provide a warranty for multinomial exercises that would soon reduce systematics to an unworkable mass of names. Compliance with the Commission’s austerities is accordingly almost universal in zoology, even when lesser varietal names are logically employed for bionomic or other purposes. Calman’s statement<sup>15</sup> on this point is the accepted law: “The only infra-specific category which is recognised by the International Commission on Zoological Nomenclature is the *subspecies*.”

Certain conclusions of basic importance to “racial anthropology” follow inevitably. They are that (1) there can be no varietal category higher than that of subspecies, which is “the highest category of varieties”; (2) a necessary corollary of the determination of a subspecies is the definition of its territory, whether geographic or otherwise; (3) the admission of contemporary subspecies of *Homo sapiens* would concede their potentialities as species and would actually promote “doctors’ disagreements” (of profound social significance) about their rank;<sup>16</sup> (4) the acceptance of subspecies or races in man must restore the correlation between race and culture which most liberal scholars now deny; and (5) the term “race” has no currency in zoology, except as a colloquial synonym for subspecies: the latest compendium of biological terms<sup>17</sup> does not even include it.

The procedures involved in separating subspecies support these conclusions. They have been exhaustively covered by the works of Huxley<sup>18</sup> and Mayr,<sup>19</sup> but it might be useful to quote Lack,<sup>20</sup> who incidentally provides a typical example of the permissible use of the word “race”:

"Subspecies (of birds), as the term implies, differ from each other to a smaller extent than do full species, the differences chiefly involving shade of plumage and size. But a more important criterion is that of geographical distribution. Subspecies of the same species always breed in separate geographical regions, and where their respective breeding zones adjoin, they often interbreed freely and intergrade in characters. On the other hand, two forms which breed in the same region without normally interbreeding are always classified as separate species, however similar they may be to each other in appearance... Difficulty occurs chiefly in regard to related forms which occupy separate geographical regions, like subspecies, but which differ from each other more markedly than is usual among races of the same species."

The views of the American ichthyologist Carl L. Hubbs,<sup>21</sup> to which reference has been made, remain to be considered in this connection. The literature provides no indication of the popularity claimed for them; and it is noteworthy that, in the reviewing section edited by Dr. Hubbs himself for *The American Naturalist*, the well-known ornithologist Alden H. Miller insists<sup>22</sup> that Hubbs' use of "the term 'race' for minor categories should not be pressed upon other workers who for long have used 'race' and subspecies' as synonyms." It need hardly be added that Dr. Hubbs makes no claim for altering or extending the rules governing the trinomial system.

The fact that zoologists know forms (mostly host-varieties) that can be called "biological races" or "ecological races" does not justify racial definitions of categories below that of subspecies, whether in man or otherwise. Anthropologists who seek proofs by analogy in these circumstances usually lack the working experience of taxonomy which inhibits such enthusiasm. For the discussion of biologically isolated populations of a species in qualified terms of "race" has a logical pattern in that it stresses environmental separation just as subspecies or "geographical race" does; and, as the "accepted meaning of subspecies" includes host-variations,<sup>23</sup> such categories are equally synonymous with subspecies when the forms included in them are adequately established. Moreover, where definitions of particular populations of subspecies are necessary, other terms are available which avoid the confusions of "race".

It should be noted, too, that the unfortunate use of the term "sociological race", for distinguishing human groups that are "socially supposed" to be racially different, derives no

sanction from ecological usage as is often supposed: it is indeed difficult to visualise more in the parallel than a resemblance of form and sound. Biological races are the products of interaction with relatively stable habitats beyond their control, but human groups cannot respond racially to the temporary influence of the most stable social situations. Therefore, "sociological race" is an incompatible proposition which cannot be accepted within the same body of knowledge. It would actually be impossible to incorporate a statement carrying the unalterably biological meaning of innate qualities (*race*), and its negation (*sociological*), in the precise language of an axiomatic system.<sup>24</sup>

A word now about the view that the classification of recent mankind is not the business of zoological taxonomy. It postulates no more than simple "lumping", augmented perhaps by typological discriminations, and its backgrounds are evident in the work of all cautious zoologists. They believe, as Darwin did, that certain cases, "precisely like that of Man", require the grouping of "all the forms which graduate into one another, under a single species"; for no one has the "right to give names to objects which they cannot define."

This diffidence lies behind the virtual abandonment of the classification of mankind by zoologists to-day. Their attitudes are typified by the work of Simpson, who regards the Hominidae as a monogeneric family, except for the possible inclusion of *Pithecanthropus* and *Eoanthropus*; and of Huxley and Haddon,<sup>25</sup> who reject the racial ideology and offer the neutral term "ethnic group" as an instrument for classifying living men. The underlying assumptions seem to be that, "since man has control over nature, the question of human 'races' must be considered on different bases to those we are accustomed to in taxonomy." In fact, according to ordinary zoological standards, there are no human races.

This is the opinion of Dr. Sunder Lal Hora in commenting upon the first outline of this paper. He attached some remarks by his colleague Dr. B. Biswas, an ornithologist, with which he was in "complete agreement". They are worth quoting:

"The classification of living mankind on the same principles as those regulating the taxonomy of other animal forms would be a futile attempt, because the criteria for grouping animals below species are practically indiscernible in human groups. For example, separate breeding territories—the chief criterion for geogra-

phical subspecies of animals—are not a characteristic of man, at least in the 'civilised' state. Mass movements and migrations, sometimes involving whole populations, have transformed *Homo sapiens* into a species consisting only of intergrades, with mere traces here and there of the original subspecies, if there were any. For these reasons, it is my contention that if the human species is to be classified at all, it should be along the lines of the classification of the different breeds of domesticated animals. And different terminologies, to avoid the use of such terms as 'race', would, of course, have to be devised with the help of systematists in biology."

The growth of a similar approach in the social sciences has found much nourishment in recent years, particularly from outstanding cultural anthropologists such as Melville J. Herskovits.<sup>26</sup> Its practice would require a reorientation of the scope and methods of anthropology, which would hasten the reabsorption of physical anthropology by zoology, just as other "special sciences", created by new techniques, opportunities and pressures (microscopy and microtomy, for instance), have lost the status they once possessed.

It must be expected that such a reorientation will be contested, especially when vested interests are involved, but it is not beyond the capacity for academic adjustment. In America and elsewhere, as Hager reports,<sup>27</sup> "this shift in emphasis...has already begun...and there has been a steady decline in the publication of descriptive racial studies, studies of 'race mixture', constitutional typing and anthropometry." Indeed, the process has gone so far that, at several major American universities, the courses in physical anthropology "have been entirely re-structured: many no longer bear that name." These changes, it should be added, are socially based; they are much more influenced than is generally recognised by the falsification of racial thinking<sup>28</sup> pioneered by Huxley and Haddon; and they are encouraged by the absence of any demand for a taxonomic background to cultural anthropology.

It would seem, then, that anthropology can function without a foundation of zoological taxonomy. But the organisation of every science depends on classification; and, if anthropology is to set up typological conventions of its own, the separation from taxonomy cannot be absolute: the systematics of extinct forms and the typology of living men must necessarily complement each other. For the definition of modern man is continuously affected by new discoveries and interpretations concerning his predecessors—and this know-

ledge must remain grounded in taxonomy. Nor can any scientific discipline ignore the elementary principle of unity of usage: common concepts, terms and definitions must keep their interchangeability; new ones should be new and logically related; and borrowings should be borrowed whole and without confusing redefinitions by inventive reformers.

It follows that any reasonable classification of man must depend upon confident familiarity with the theory and practice of zoological taxonomy; and, for this reason, Huxley's cline typology might offer a workable method—at least to those who believe that the types of mankind can be clearly differentiated. But, whatever the method, it should have the flexibility which has allowed taxonomy to contain extremes of "splitting" and "lumping" without damage to its structure.

Finally, the indications are that individual refinements of the classificatory study of man, particularly when they follow the neo-classical rituals of limited metric analyses or express personal idiosyncrasies, are unlikely to produce more than further controversy. Revised approaches and wide co-operation, sufficiently rooted in objective realities to resist the pressure groups which have vitiated recent pronouncements on "race", are now imperative. And Indian zoologists and anthropologists are uniquely circumstanced, since they are little impeded by Western racial ideologies, for promoting the new directions that are necessary. They can provide, in these ways, another substantial contribution from India to the welfare and wisdom of humanity.

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1. Annandale, N., *Nature*, 1921, **108**, 370.
  2. Wood Jones, F., *Man*, 1930, **30**, 61.
  3. Simpson, G. G., *Bull. Amer. Mus. Nat. Hist.*, 1945, **85**, 181 & 198.
  4. Trevor, J. C., *Chambers' Encyclopaedia* (Newnes, London), 1950, **11**, 428.
  5. Dr. Trevor's dictionary usage of the word "polymorphic" reveals that he is unaware that in zoology a "polymorphic species" is one in which there are six kinds of individuals associated with biological phenomena—e.g., the different females of mimetic butterflies, *H. sapiens* is a polytypic species.
  6. Trevor, J. C., *Journ. Roy. Anthropol. Inst.*, 1950, **77**, 63n.
  7. Lord Rothschild and Jordan, K., *Nov. Zool.*, 1903, **9** (Suppl.).
  8. Schenk E. T. and McMasters, J. H., *Procedure in Taxonomy* (Stanford Univ. Press, California), 1936.
  9. Regan, C. T., *Ann. Mag. Nat. Hist.*, 1923, **12** (6), 167.
  10. Annandale, N., *Proc. Roy. Soc.*, 1924, **96B**, 76.
  11. Hora, S. L., *Phil. Trans. Roy. Soc.*, 1930, **218 B**, 172.
  12. Tokens of its contemporary persistence will be

- found in *Lectures on the Development of Taxonomy*, edited by G. R. de Beer (Linnaean Society of London, 1950) and S. L. Hora's Address on Adaptation and Evolution in *Proc. National Inst. Sci. India*, 1952, 18, 161-70.
13. Just, E. E., *Amer. Nat.*, 1938, 70, 267-312; and *The Biology of the Cell Surface* (Blakiston, Philadelphia), 1939. Also F. Wood Jones, *Proc. Linn. Soc. Lond.*, 1945, 157, 11-14. 14. Morton, A. G., *Soviet Genetics* (Lawrence and Wishart, London), 1951. 15. Calman, W. T., *The Classification of Animals* (Methuen's Biological Monographs), 1949. 16. Dobzhansky, T., *Amer. Journ. Phys. Anthrop. (n.s.)*, 1944, 2, 251-62; and Gates, R. R., *tom. cit.*, 279-92. "A subspecies," says Mr. Tam in this connexion, "is a species of which we know the geographical history." 17. Abercrombie, M., Hickman, C. J. and Johnson, M. L., *A Dictionary of Biology* (Penguin Reference Books, London), 1951. 18. Huxley, J. S., *et al.*, *The New Systematics* (Oxford Univ. Press), 1940. 19. Mayr, E., *Systematics and the Origin of Species* (Columbia Univ. Press, New York), 1942. 20. Lack, D., *Darwin's Finches* (Cambridge Univ. Press), 1947. 21. Hubbs, C. L., *Ann. N. Y. Acad. Sci.*, 1943, 44, 111. 22. Miller, A. H., *Amer. Nat.*, 1943, 77, 552. 23. Bethune-Baker, G. T., *et al.*, *Proc. Entom. Soc. Lond.*, 1925, iv, 1. 24. Kaufman, F., *Methodology of the Social Sciences* (New York), 1944; and Woodger, J. H., *The Axiomatic Method in Biology* (Cambridge Univ. Press), 1937. 25. Huxley, J. S. and Haddon, A. C., *We Europeans* (Cape, London), 1935. In the U.S. particular credit for advancing the views of Huxley and Haddon belongs to M. F. Ashley Montagu (for example, see *Psychiatry*, 1945, 8, 27-33). 26. Herskovits, M. J., *Man and His Works* (Knopf, New York), 1948. 27. Hager, D. M., *Man*, 1951, 51, 54. 28. Dover, C., *Ibid.*, 1951, 51, 55.

*Note*.—An essential statement by S. L. Hora on the taxonomic assessment of a species will be found in *Journ. Zool. Soc. India*, 1949, 1, 91-100.

### PAPYROGRAPHIC STUDIES ON PEPTIDES

BHARATHI BHEEMESWAR AND MOTNAHALLI SREENIVASAYA

(Indian Institute of Science, Bangalore)

RANGA RAO AND SREENIVASAYA<sup>1</sup> have shown that the non-protein nitrogen (N.P.N.) fraction of the body fluids of the lac insect (*Laccifer lacca*) contains simple crystalloid peptides, non-precipitable by trichloroacetic acid. Milks obtained from different types of mammals<sup>2</sup> and pulses<sup>3</sup> have also been shown to be associated with high percentages of N.P.N. whose presence therein is believed to be responsible for the ease with which they are assimilated. Peptides are widely distributed and are intimately associated with all active and proliferating tissues—both plant and animal—and owe their existence to the continual breakdown and resynthesis of proteins which characterise living tissues and body fluids. Particularly rich is their concentration in the body fluids of animals and the saps of plants, since their role is one of providing tissues with an easily mobilisable source of nitrogen exceptionally adaptable for rapid tissue formation.

Special physiological significance is attached to some of the peptides; they have been found to act as co-enzymes or activators, essential growth factors or antibiotics. Glutathione,<sup>4,5</sup> the well-known tripeptide, for example, is a co-enzyme of methyl glyoxylase, an activator of papain<sup>6</sup> and an effective stabiliser of ascorbic acid.<sup>7</sup> Its unfailing presence in actively proliferating tissues is suggestive of the suspicion that glutathione may have other functions

yet undiscovered. More recently, glutathione,  $\gamma$ -glutamyl, and acyl peptides have been shown to participate in the enzymatic transpeptidase reactions.<sup>8,9</sup> Streptogenin<sup>10</sup> which was discovered by Woolley in 1944, and which has been shown to be present in most of the proteins of high biological value,<sup>11</sup> stimulates the growth of certain bacteria. Subsequently other investigators have sought to isolate other peptides from enzymatic digests of proteins and determine their growth-promoting potency. Agren<sup>12</sup> has found significant increases in the growth of children fed with peptides resistant to the action of catheptic enzymes. Dunn<sup>13</sup> has recorded the stimulating effect of partially hydrolysed digests of casein and of the albumin of bovine plasma, on *L. casei* resulting in a higher rate of acid production. It was shown that the organism utilised the essential amino acid more readily when provided in a peptide-bound form. Simonds and Fruton<sup>14</sup> have also observed that a mutant of *E. coli* utilises for growth peptides of proline at a faster rate than proline. A genus of "alcaligenes" utilised leucine peptides only when leucine was present at the amino end of the unsubstituted peptide.

Another entirely new group of peptides, which has received considerable attention, is derived from the culture filtrates of bacteria, e.g., polymyxins, gramicidin, tyrocidine and Tyrothricin.<sup>15</sup> The structure of these antibiotic-

tically active peptides have been thoroughly elucidated and in the accomplishment of this task, papyrographic<sup>16</sup> and column chromatographic methods<sup>17,18,19</sup> have been extensively employed.

Fractionation, isolation and characterisation of such peptides present in enzymatic digests of proteins, body fluids, bacterial filtrates, etc., have presented problems difficult to solve but the recent techniques of papyrography and column chromatography promise to provide the means of achieving the objective with exceptional ease and elegance. Stein and Moore,<sup>17,18,19</sup> have extended the use of starch columns for a fractionation of the protein hydrolysates and more recently, Ottesen and Villee<sup>20</sup> have employed starch column chromatography for fractionating the peptides released during the enzymatic transformation of ovalbumin to plakalbumin. Papyrographic technique has been employed by Jones<sup>21</sup> and Cutch, et al.,<sup>22</sup> in a study of the separation and amino acid make-up of the polymyxins.

The present study is devoted to a determination of the Rf values of some nine peptides and three chloracetyl derivatives of amino acids employing two solvent systems and describes special methods for the location and characterisation of certain aromatic amino acid peptides. These methods have been developed mainly with the objects of applying them to a study of the nitrogenous constituents associated with haemolymph and the silk gland of the silkworm.

#### Experimental

The synthetic peptides employed in our studies were all obtained from Hoffman La Roche (Switzerland). Aliquots of 1  $\mu$ l. of a 1.0 per cent aqueous solution of the peptide were employed for spotting along a line drawn 2 cm. above the edge of a rectangular sheet (28 cm.  $\times$  22 cm.) of Whatman No. 1 filter sheet. Spacing the spots 2 cm. apart, 13-14 spots could be accommodated on the sheet for a one-dimensional development of the papyrogram. The "spotted" sheet was rolled into a cylinder, which was then left in the developing chamber containing the solvent system, butanol—acetic acid—water (10 : 2.5 : 10) or pyridine—water (4 : 1), for a couple of hours with a view to have the cylinder equilibrated with the vapour phase of solvent system. At the end of this period, the cylinder was carefully lowered into the flat-bottomed dish containing the developing solvent. The development of the papyrogram, which was conducted at the room tem-

perature (24° C.) takes 5-6 hours. The cylinder was then removed from the chamber, unfolded and the sheet air dried.

First an ultra-violet print (U.V.P.) was taken by the method of Markham and Smith;<sup>23,24</sup> then the paper was sprayed with 0.2 per cent. solution of ninhydrin in water-saturated butanol. The paper was then air dried and after making observations, the paper was further dried in a hot-air-oven (80° C.) for 10 minutes and again examined for the ninhydrin positive spots. The Rf values of amino acid derivatives and the peptides have been determined in the usual way, making use of both the ninhydrin positive and the ultra-violet opaque spots obtained in the U.V. print in the case of some of the "aromatic" peptides (see Table I). Observations made during the period of drying of the ninhydrin sprayed papyrogram, showed that a few of the spots appeared earlier than others. For example, alanyl glycine, glycyl glycine and diglycyl glycine were among the first to show the colours. The colours developed by glycyl glycine and di-glycyl glycine to begin with, are yellow which, later develops into a brownish pink.

TABLE I

Peptides	Butanol water	Ultra-violet print	Pyridine water
Alanyl glycine	0.33	..	0.4
Glycyl glycine	0.26	..	0.25
Diglycyl glycine	0.22	..	..
Leucyl glycine	0.60	..	0.63
Leucylglycyl glycine	0.52	..	0.68
Glycyl-tryptophane	0.54	0.54	0.60
Glycylleucine	0.66	..	0.55
Glycyltyrosine	0.46	0.46	0.65
Glutathione	0.19	..	0.13
Chloracetyltyrosine	..	0.97	..
Chloracetyltryptophane	..	0.98	..
Chloracetylleucine	..	..	..

It will be seen (Table I) that the Rf values of the peptides obtained with the two solvent systems do not overlap; they are sufficiently wide apart to permit discrete separations of peptides in mixtures. Further, the individual spots of the peptides are smaller and more compact, a circumstance which adds to the efficiency of discrete separations and effective locations of spots either by the U.V.P. or the ninhydrin method. The U.V. printing of the pyridine-water developed papyrogram, is not possible in view of the fact that the residual pyridine which is difficult to eliminate from the

papyrogram itself absorbs the ultra-violet radiation.

Of the peptides and amino acid derivatives which have been studied, the chloracetyl derivatives of leucine, tryptophane and tyrosine do not react with ninhydrin, since they have no free amino group. The location of two of the "aromatic" amino acid derivatives on the papyrogram was carried out by the U.V.P. method while the location of the leucine derivative is not possible. The spots of the aromatic amino acid derivatives and peptides could also be detected by reacting the papyrogram with dimethyl p-aminobenzaldehyde for the characterisation of the tryptophane peptide which yields a violet spot while the tyrosine derivative could be located by the brick-red colour developed with Millon's reagent.

The peptide spots were individually excised from the papyrogram, extracted with hot water by means of a microfilter, and the extracted peptide concentrated to a small volume in vacuum over silica gel. The solution was then hydrolysed in a sealed tube with 5 N hydrochloric acid for 2·5 hours at 100° C. The hydrolysate was freed of its HCl and concentrated by evaporating the solution in vacuum over caustic potash and sulphuric acid placed separately in a desiccator. The hydrolysate, when spotted and developed, gives the constituent amino acids of the peptide.

It will be seen from the preceding discussion that papyrographic methods when coupled with U.V.P. and micro-hydrolysis techniques, are useful for a separation and characterisation of the peptides and amino acids when they occur

in mixtures as they do in enzymatic digests of proteins, plant saps, body fluids and tissue extracts. These methods, together with two-dimensional papyrographic methods, are being extended to a study of the haemolymph and the silk gland of the silkworm.

Our sincere thanks are due to Professor M. S. Thacker, Director, Indian Institute of Science, for his kind interest.

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#### POPULARISATION OF SCIENCE

THE problem of popularizing scientific knowledge, that is to say, its dissemination amongst non-specialists, has to-day become a very important and very delicate problem: very important because it is essential that public opinion at all levels should be able to understand the scope of scientific progress, its intellectual value, and the tremendous repercussions which

it can have on the future life of all peoples and on the evolution of their civilisation; very delicate because scientific knowledge is becoming more extensive and more complex each day, so that it is very difficult to make it comprehensible for the general public without an unfortunate distortion of some of its aspects.

PROF. LOUIS DE BROGLIE.

#### CENTRAL AID FOR FUNDAMENTAL RESEARCH

WITH a view to promoting fundamental research in Universities and other educational centres, the Central Government have decided to set apart a small amount for giving grant-in-aid to individual research workers who have been experiencing difficulties in the furtherance of their work. The grants will be made available for the purchase of special apparatus

or for its construction, for consumables, stores, books, etc. Applications are to be addressed to the Secretary, Ministry of Education (Technical Education Division), giving full particulars concerning the lines of research on which they are engaged, the type of assistance required and any other relevant information useful for consideration of the cases.

## LETTERS TO THE EDITOR

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**ANOMALOUS EFFECTIVE ROTATIONAL TEMPERATURE OF HgH BANDS**

THE emission bands of HgH, particularly those belonging to the transition  $A^2\Pi \rightarrow X^2\Sigma$  are interesting from more than one point of view, such as predissociation by rotation,<sup>1</sup> nuclear isotope effect,<sup>2</sup> abnormal effective rotation temperature,<sup>3</sup> etc. It has been found that the intensity distribution among the rotational lines of the bands belonging to the above transition does not admit the possibility of evaluating the effective rotational temperature because of the fact that the plot of  $\log (I/i)$  against  $J'(J'+1)$ , does not yield a straight line.<sup>3</sup> Restricting oneself to low  $J'$  values where the plot is a straight line, effective rotational temperatures of the order 900° K have been deduced. Such a value obtains not only when the bands are produced by a discharge through mercury vapour and hydrogen<sup>4</sup> employing a current of 0.6 to 50 m.amps., and a voltage of 400 but also when the bands are produced by sensitised fluorescence at room temperature.<sup>5,6</sup>

As the bands could be produced easily by sending a high frequency discharge through a tube containing sufficiently large quantities of mercury and hydrogen using external electrodes an investigation was made of the abnormality of rotation temperature under these discharge conditions.

Using a low power oscillator (10-12 watts) built on a modified Hartley circuit, it was found that no discharge occurred unless the tube was heated to a temperature of about 230° C. Accordingly the discharge tube was kept in a sufficiently long electrical furnace whose temperature could be regulated up to a maximum of about 350° C. The bands were best developed when the temperature of the furnace was between 230° and 245° C. and the spectra at temperatures 231° and 237° C. were photographed using a three-prism glass spectrograph.

From a visual estimation of the relative intensities of the rotational lines of the bands 4520 Å (0-3) and 4394 Å (0-2) belonging to the transition  $^2\Pi_{\frac{1}{2}} \rightarrow ^2\Sigma$  their effective rotation tem-

perature was found to be roughly  $1100^{\circ}$  K for the former and  $1000^{\circ}$  K for the latter. The plot of  $\log(I/i)$  against  $J'(J'+1)$  deviated considerably from a straight line for values of  $J'$  greater than 5 and the above temperatures were obtained by neglecting such points. In this respect these results are similar to those obtained in the other modes of excitation, and point to the fact that the distribution of the molecules in the excited rotational states is not Maxwellian. This conclusion was corroborated by measuring the relative intensities,  $I_1$ ,  $I_2$ ,  $I_3$ , at the three temperatures  $231^{\circ}$  C. ( $T_1$ ),  $234^{\circ}$  C. ( $T_2$ ),  $237^{\circ}$  C. ( $T_3$ ) respectively, of several rotational lines, of the (0-0) band at  $4,017\text{ \AA}$  belonging to the transition  ${}^2\Pi_g - {}^2\Sigma$ . The following values were found for the factor  $\log(I_1/I_2)/\log(I_1/I_3)$  in the case of a number of lines, selected at random: 1.314, 1.296, 0.399, 0.323, 0.660, 0.720, 0.960, 0.420. If the distribution was Maxwellian the values should all be the same and equal to  $T_3(T_1 - T_2)/T_2(T_1 - T_3)$  which has a value of 0.653.

I wish to thank Dr. R. K. Asundi for guidance in this work.

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Banaras Hindu University,  
May 28, 1952.

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#### THE TERTIARY BEDS OF VINJHAN-MIANI AREA, SOUTH-WESTERN CUTCH, INDIA

VERY little has been added to our knowledge of the Tertiary rocks of Cutch since the work of Wynne,<sup>1</sup> Vredenburg,<sup>2</sup> and Nuttall,<sup>3</sup> and a classification of these beds on the basis of the contained foraminifers has not yet been attempted. I visited parts of Cutch in 1949 and made a detailed study of the Tertiary rocks exposed in the neighbourhood of Vinjan ( $23^{\circ} 6' : 69^{\circ} 2'$ ) and Miani ( $23^{\circ} 7' : 69^{\circ} 6'$ ) area in the south-western part of the island. The rocks are well exposed and a continuous section of the strata, which are gently folded can be followed in the Kankavati river, which tra-

verses this area. The sequence of beds with the contained fossils is as follows:

Bed (5). Coarse-grained sandstones and shales with intercalated bands of limestones several hundred feet thick. A few fossils were noticed in the lower calcareous band, which has yielded *Balanus* and smaller foraminifers. These have not been examined in detail. The bed may be equivalent of a part of the Manchhars (Middle Miocene to Pliocene) of the Western Pakistan.

Bed (4). The bed is composed of shales and is about 900 feet thick. The bed contains throughout *Taberina malabarica* (= *Orbiculina malabarica*). The upper 30 feet of this bed is rich in molluscs and the following have been identified: *Turbinella mekranica*, *Strombus mekranicus*, *Venus (Omphalocladrum) mekranica*, *Dosinia subpencillata*. All these are found in the Talar stage (Pontian) of Baluchistan. These molluscs have not been noticed in the underlying strata, which has yielded the following foraminifers: *Taberina malabarica*, *Miogypsina* sp., *Miogypsinoides* sp., *Miolepidocyclus* sp., *Austrotrillina houchini*. Along with the above foraminifers *Ostrea* (*Lopha*) *virleti* and *Ostrea digitata* are also found. No Lepidocyclines have been noticed in this bed. *Ostrea* (*Lopha*) *virleti* and *Ostrea digitata* are found in the Talar stage (Pontian) of Baluchistan and Akauktang bed (Vindobonian) of Burma. The bed is post-Gaj in age and the presence of *Miogypsina* and *Miogypsinoides* indicates that it is not younger than the Middle Miocene (Vindobonian) and it may be, therefore, correlated with the Vindobonian (Middle Miocene).

Bed (3). Loose and coarse-grained sandstones showing current bedding, a little more than 200 feet in thickness. No mega-fossils have been procured from this horizon. The beds are provisionally referred to the Nari Series (Oligocene).

Bed (2). This bed is composed of limestones and marls of about 500 feet in thickness. The following fossils have been identified: *Nummulites acutus*, *Nummulites obtusus*, *Nummulites stamineus*, *Nummulites maculatus*, *Alveolina elliptica*, *Dictyococonoides cooki*, *Discocyclina dispansa*, *Discocyclina javana* var. *indica*, *Discocyclina undulata*, *Discocyclina sowerbyi*, *Hantkenina* sp., *Linderina* sp., *Halkyardia* sp. The contained fauna indicates lower part of Middle Kirthar (Lutetian) age of these beds.

Bed (1). Shales about 50 feet in thickness, which appear to be unfossiliferous. Wynne called these sub-nummulitic group and this

may be of Laki age. Below this are the Deccan Traps.

The Upper Kirthars and the equivalents of the *Pellatispira* bed (Priabonian) of Surat<sup>4</sup> are not present in this area.

Among palaeontological results obtained mention may be made of the discovery of the foraminiferal genera *Halkyardia*, *Linderina* and *Hantkenina* from the Middle Kirthars of this area. These fossils are being recorded for the first time from India, and it may be noted that *Hantkenina* is confined to the Eocene and has a wide geographical distribution. Species of this genus are regarded as index fossils for different subdivisions of the Eocene. *Taberina malabarica* (= *Orbiculina malabarica*) is also being recorded for the first time from Cutch, and appear to be of Vindobonian age. Henson<sup>5</sup> has recently discovered *Taberina malabarica* from the Lower Fars limestones (Middle Miocene) of the Middle East.

I am grateful to Prof. S. R. N. Rao for guidance and encouragement in this work.

Dept. of Geology,  
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Lucknow,  
March 25, 1952.

B. S. TEWARI.

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#### EFFECT OF SOAP CONCENTRATION ON THE INTERFACIAL TENSION OF SOME ALIPHATIC ALCOHOLS AND ESTERS

It is generally observed that the interfacial tension at the oil-water interface decreases with the increasing concentration of soaps, oleates, stearates, etc., in water, till a limiting value is reached. This may be accounted for on the basis of the mono-molecular layer theory of adsorption of fatty acid radical on the interface of the oil droplet.

In our work it has been, however, noticed that the interfacial tension for some liquids like hexyl and octyl alcohols, and propyl, butyl, amyl acetates, etc., is initially found to increase with increasing soap concentrations for dilute solutions, followed by usual decrease in interfacial tension with further increase in soap concentration. With saponin, however, such a behaviour as observed with dilute soap solutions, is not observed.

The interfacial tension of liquids against aqueous phase in presence of soaps was measured by the drop number method using a microsyringe (Burrows and Welcome) which gives the volume of a single drop with an accuracy of 0.0004 c.c. The final values for the interfacial tension were obtained by applying Harkins' Correction Factor for the size of the drop.<sup>1</sup> The effect of soap concentrations on the interfacial tensions of sec. octyl alcohol and normal butyl acetate against sodium oleate solutions is indicated in Fig. 1.

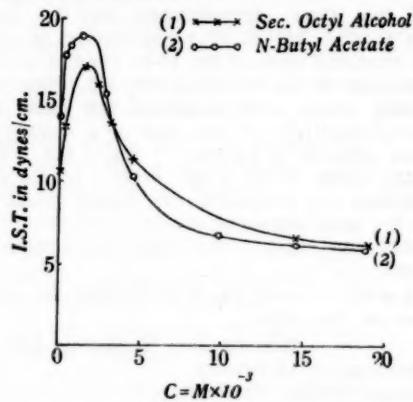


FIG. 1

The interesting behaviour of the liquids may be explained on the basis of the reversal of electrical double layer at the oil-water interface and further that these liquids have a ring structure postulated by Smith and McReynolds.<sup>2</sup> They have stated that the data of esterification, saponification, dissociation constants, irregularities in optical rotatory power and other anomalies may be explained on the basis of ring structure through hydrogen bond. The formation of ring structure has been also postulated by Evans and others.<sup>3</sup> This type of ring must, by its very nature, be quite unstable. The details of the experimental results and the discussion will be published elsewhere. Further work along this line on different alcohols, esters, ketons, etc., is also in progress.

Chemistry Dept.,  
M. T. B. College,  
Surat,  
February 5, 1952.

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**A NOTE ON SUBCUTANEOUS  
TOXICITY OF MORELLIN AND ITS  
SUITABILITY FOR TOPICAL  
APPLICATION**

WITH reference to a report<sup>1</sup> on the toxicity of morellin (the antibiotic<sup>2</sup> from *Garcinia morella*) and its unsuitability as a therapeutic agent, we have found that 2-4 per cent. solutions of morellin in sterile olive oil could be readily administered subcutaneously to mice (average weight 20-23 g.) without causing any mortality or necrosis in doses upto 450 mg. per kilogram body weight. Emulsions of the drug in Dupenol (sodium lauryl sulphonate) are not so satisfactory. The reported toxicity appears to be due to settling out of the drug at the site of injection, thus causing local irritation and necrotic lesions. The drug must be in solution in order to obviate these reactions.

2 per cent. olive oil solutions and 1 per cent. lanolin ointment have been found to be suitable for topical applications in the treatment of septic wounds and ulcers caused by pathogenic cocci, and in cases of bovine mastites.<sup>3</sup> A detailed report of the clinical trials now in progress will be published shortly.

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April 22, 1952.

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**THE INHIBITION OF THIAMINASE  
BY MICRO AMOUNTS OF  
ACETALDEHYDE**

DURING the course of an investigation on the mode of action of the carboxylase inhibitors, it was noticed that different types of curves resulted for the progressive output of CO<sub>2</sub> in a Warburg respirometer when to the co-carboxylase-pyruvate system, the thiaminase from Bombay Duck (*Hopredon nehercus*) was added at the start of the experiment and after a lapse of one-and-a-half hours. Fig. 1 is a typical example.

It was thought that probably the difference in the behaviour was due to the products of pyruvate degradation, which were present in one case and were absent in the other. To test this, a series of experiments were carried out

using the human serum or the rat liver as a source of active co-carboxylase. The following combinations were studied.

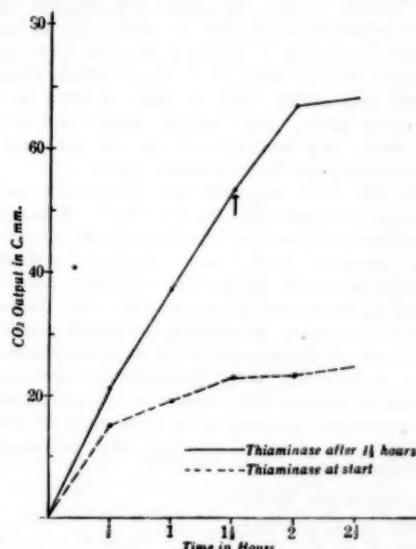
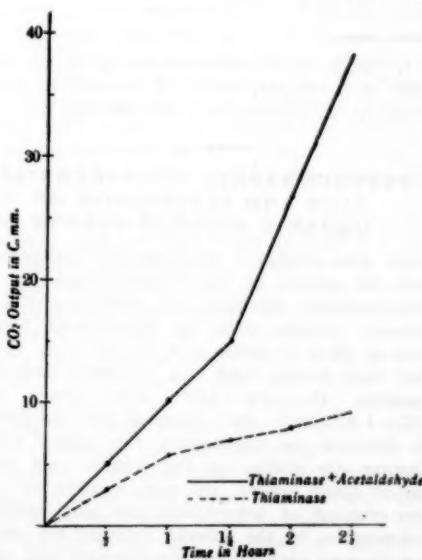


FIG. 1



- (1) (a) Serum + thiaminase.  
(b) Serum + thiaminase + acetaldehyde  
0.0025%.

- (2) (a) Liver + thiaminase.
- (b) Liver + thiaminase + acetaldehyde  
0.0025%.

Typical curves of such experiments with serum are shown in Fig. 2, which may be compared with Fig. 1. Series 1 (b) and 2 (b) gave results almost identical to those where thiaminase was added after a lapse of time in the original series. The findings thus suggest that probably the acetaldehyde is the inhibitor of the thiaminase from Bombay Duck.

It has been reported that thiaminase is inhibited by salts of Zn, Cu, Fe.<sup>1</sup> Substances like neopyrithiamine also inhibit the action of the enzyme from carp viscera.<sup>2</sup> o-Amino-benzyl-4-methyl thiazolium chloride, however, does so by virtue of competition with thiamine for the enzyme. At present the exact metabolic function of thiaminase in fish is not understood. Its relationship with acetaldehyde—a normal product—during the oxidative decarboxylation of pyruvate—appears to be interesting. Further work is in progress to study this relationship in more detail.

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#### PAPYROGRAPHIC CHARACTERISATION AND ESTIMATION OF ORGANIC ACIDS IN PLANTS

LUGG AND OVERELL<sup>1</sup> modified the composition and the nature of the solvent phase for the papyrographic detection and separation of non-volatile organic acids by substituting formic acid in place of acetic acid, on the basis of the fact that formic acid had a higher ionization constant ( $K = 2.0 \times 10^{-4}$ ) than acetic acid ( $K = 1.8 \times 10^{-5}$ ); they reported that the former is effective in suppressing the comet effect. During our studies on the organic acid make up of plant tissues, we were confronted with the problem of determining the most effective composition of the solvent mixture for securing discrete separations and compact and well-defined spots. The following solvent mixtures were compounded and employed for papyrographic separation of organic acids.

TABLE I  
Composition of solvent mixtures

Solvent mixtures	1	2	3	4	5
Butanol	..	10	10	10	10
Gasoline	..	..	..	..	..
Acetic acid	..	2.5	1.2	..	..
Formic acid	..	..	..	2	2
Water	..	10	4	6	5

Lugg and Overell<sup>2</sup> showed that 1-2 moles of acetic acid per litre of the phase, gave the best separation. By trying various concentrations of acetic acid, we found that mixture No. 2 (Table I) gave a better separation than mixture No. 1. Four volumes of water were taken for mixture No. 2, since this amount of water was found to be just sufficient to give two separate layers when mixed with 10 parts of butanol and 1.2 parts of acetic acid.

Similarly in the formic acid series the mixture composed of 10 butanol : 2 formic acid : 5 water, gives the best separation and also the yellow bands at the bottom of the chromatogram totally disappear. Besides, the substitution of formic in place of acetic acid gives better and more well-defined spots and *Rf* values (Table II) which are reasonably wide apart. A trial run with a solvent mixture of gasoline and butanol<sup>3</sup> did not yield any encouraging results in our hands (Table II). Best resolutions were obtained with solvent mixture No. 4; we have accordingly adopted this solvent mixture for all our studies.

**Experimental.**—The fruits chosen for our investigation were :

(1) *Averrhoa carambola* Linn.; (2) *Citrus decumana* Linn. (Pomello); (3) *Citrus limonum* (Lemon); (4) *Citrus medica* Linn. (Bitter lime); (5) *Citrus sinensis* (Orange); (6) *Morus indica* Linn. (Mulberry leaf); (7) *Phyllanthus emblica* Linn. (Gooseberry); (8) *Phyllanthus simplex* Retz.; (9) *Punica granatum* Linn. (Pomegranate); (10) *Tamarindus indica* Linn. (Tamarind); (11) *Vitis vinifera* Linn. (Unripe grapes); (12) *Ziziphus jujuba* Lamk.

Fleshy portions of the fruits (10-15 g.) were ground up with 50 per cent. alcohol acidified with acetic acid, and the mash strained through cheese cloth. The extract was made up to 20 ml., centrifuged and the clear supernatant used for papyrographic studies (preserved in a refrigerator in small bottles). Measured quantities of the extracts were spotted on rectangular sheets (20 × 22 cm.) of Whatman No. 1,

TABLE II  
\* R<sub>f</sub> values with different solvent mixtures

Organic acids	Solvent mixture No. 1	Solvent mixture No. 2	Solvent mixture No. 3	Solvent mixture No. 4	Solvent mixture No. 5
Aconitic	..	0.64	0.63	..	0.78
Citric	..	0.30	0.26	..	0.37
Fumaric	..	0.72	0.73	..	0.86
Glutaric	..	0.70	0.80	..	0.70
Itaconic	..	0.70	0.77	..	0.81
Lactic	..	..	0.63	..	0.77
Maleic	..	..	0.32	..	0.46
Malic	..	..	0.37	..	0.44
Malonic	..	..	0.42	..	0.60
Oxalic	..	..	0.17	..	0.05
Succinic	..	..	0.73	..	0.72
Tartaric	..	..	0.22	..	0.23
Tricarballylic	..	..	0.63	..	0.67
Remarks	Tailing; spots not clear; a yellow band at the bottom	Tailing; the yellow band present	Unsatisfactory; spots are not well-defined; tailing	No tailing; spots compact and clear; yellow band at the bottom absent	..

\* Average for four values

rolled into the form of cylinders. After equilibration with the vapour phase in the developing chamber, papyrograms were developed with the solvent mixture No. 4 at room temperature (25–26° C.) which generally took 5–6 hours. The papyrograms were then air-dried over night and later oven-dried at 80° C. for 30 minutes. After spraying with bromo-cresol-green (40 mg./100 ml. 95% alcohol).<sup>4,5</sup> The

presence of the different acids was indicated by well-defined lemon yellow spots against a blue background, and by developing papyrograms of known reference mixtures along with those of extracts and by a reference to the R<sub>f</sub> values determined by us (Table II), the acids occurring in the mixture could be characterized. The area occupied by a given spot was found to give us a measure of the quantity of the acid present in the extract. Since the quantity of the extract used for spotting is known, it has been possible to express the quantity of the constituents of the mixture as milligrams per ml. The results are given in Table III.

Of the citrus fruits examined, the *Citrus limonum* contains the highest amount of citric and also a surprisingly high proportion of oxalic acid. Among the non-citrus fruits, *Punica granatum*, the acid variety of pomegranate, contains citric acid to the extent of 95 per cent. with a trace of oxalic acid. It is surprising that *C. decumana* does not contain any citric but only oxalic acid. Tamarind contains, as expected, about 88 per cent. of tartaric acid, malic accounting for the remaining portion of the acidity. No other acids are present. The grape contains exclusively the tartaric and malic acids in almost equal proportions. The two members of the phyllanthus family—*P. emblica* and *P. simplex*—show interesting differences. The medicinally important *Emblica* show high proportions of the citric and malic

TABLE III

Plant material	Organic acids mg./ml.				
	Citric	Malic	Oxalic	Succinic	Tartaric
1 <i>Averrhoa carambola</i> Linn.	..	5.39	..	..	..
2 <i>Citrus decumana</i> Linn.	..	..	2.50	..	..
3 <i>Citrus limonum</i>	74.36	4.01	20.00	7.50	..
4 <i>Citrus medica</i> Linn.	18.12	1.37	2.18	..	..
5 <i>Citrus sinensis</i>	3.67	1.07	..	..	..
6 <i>Morus indica</i> Linn.	..	..	..	0.52	0.36
7 <i>Phyllanthus emblica</i> Linn.	9.60	13.50	3.53	..	1.29
8 <i>Phyllanthus simplex</i> Retz.	..	..	15.00	..	..
9 <i>Punica granatum</i> Linn. (acid variety)	37.57	..	1.2	..	..
10 <i>Tamarindus indica</i> Linn.	..	1.37	..	..	10.63
11 <i>Vitis vinifera</i> Linn.	..	5.00	..	..	4.88
12 <i>Ziziphus jujuba</i> Lamk.	12.17	3.46	4.47	..	..

acids with low percentages of oxalic and tauric acids while simplex consists of only oxalic acid to the absolute exclusion of other acids.

Our grateful thanks are due to Prof. M. S. Thacker, Director, Indian Institute of Science, for his kind interest.

Indian Institute of G. D. KALYANKAR.  
Science, P. R. KRISHNASWAMY.  
Bangalore-3. M. SREENIVASAYA.  
June 11, 1952.

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#### AN AQUATIC GLOW-WORM FROM ALLEPPEY

THE earliest record of aquatic Lampyrid larvæ is that of Annandale<sup>1</sup> from Malaya. In 1906, the same author<sup>2</sup> recorded another larva, *Luciola vespertina*, from Calcutta. Later the larva of *Pyrophanes similis* was recorded by Blair<sup>3</sup> from S. Celebes and the aquatic larvæ of two species of *Luciola* were collected by Okada<sup>4</sup> from Japan.

All the above forms are different from the aquatic Lampyrid larva collected in November, 1951, from a weedy fresh water tank at Alleppey, about a mile and a half from the sea-coast. The larva is purely aquatic and it lived in water for over a month, after which it was preserved.

The larva measures about 21 mm. in length. It is sooty brown above with faint ochraceous longitudinal stripes along the dorsal carinae which characterise the tergites. The structure of the head and the mouth parts and also the nature of the carinae and posterior marginal protuberances of the tergites resemble more or less the larva formerly described by the author<sup>5</sup> from a marshy locality at Trivandrum. The present larva seems to be an advanced instar of the larva from Trivandrum, which also must have been aquatic. This differs from *L. vespertina*, the only other aquatic Lampyrid larva known from India, in the absence of the star-shaped funnel-like adaptation for respiration. But as Annandale does not give the minute structural details of the larva and as the star-shaped funnel referred to may be the "anal brush," so characteristic of all Lampyrid larvæ, it is not possible to consider the two larvæ as belonging to the same species.

The present larva is a voracious feeder on the fresh-water snail, *Planorbis exustus*. While feeding it curls up the abdomen and emits a powerful light from inside water. The larva avoids light and clings to the weeds and thus remains hidden during the daytime. It is interesting to note that all the hitherto recorded species of aquatic Lampyrid larvæ are Asiatic and they have been recorded only from India, Malaya, S. Celebes and Japan.

Dept. of Zoology, J. SAMUEL RAJ.  
Sanatana Dharma College,  
Alleppey, S. India,  
March 31, 1952.

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#### MYIASIS OF THE URINARY PASSAGE IN HUMAN MALE

MYIASIS of the human urinary passage appears to be extremely rare.<sup>1-4</sup> Most of the myiasis-producing Diptera in man listed by Strickland and Roy<sup>5</sup> were recorded from places other than the urinary passage. Riley and Johansen<sup>6</sup> refer to two species of maggots, viz., *Fannia canicularis* from a woman having albuminuria and *Psychoda albipennis*, from a boy in Scotland. Species of *Chrysomyia* and *Lucilia* have been successfully reared for a few days in human urine.

The present record is from a young man, who appears to have got the infection some months back. During each micturition, he was passing out about a dozen maggots. This continued for over two months and now he has ceased to produce them. The patient does not seem to have been affected seriously.

The larvæ passed out at a time belong to more than one instar and they live in the urine outside for a few hours only. They are pale yellow in colour and cylindrical in shape, with attenuated anterior end (Fig. 1). The maggots measure from 4 mm. to 7 mm. in length. The body is twelve-segmented. The cephalopharyngeal sclerites are well developed. The mandibular sclerites are paired and sharp. The respiratory system is amphineustic with anterior spiracles digitately lobed and posterior spiracles borne at the end of a pair of minute tubercles (Fig. 2). The posterior spiracles are incompletely sclerotised and each consists of three chitinous areas with three bunches of setæ. The

structure of these maggots reveals the fact that these are different from all the myiasis-producing larvae recorded so far. Attempts to rear the maggots into flies have failed and it is impossible at present to make a specific identi-



FIG. 1

FIG. 2

Maggots from human urine.

Left:—Two maggots entire,

Right:—Posterior end showing spiracles.

fication of the maggots. I place them under the family *Anthomyidae*. I also believe that the man must have acquired infection through the flies laying eggs at the external meatus and the minute larvae hatched out creeping directly upto the bladder. A more detailed work on the minute anatomy of these maggots is in progress.

My thanks are due to Dr. S. P. Pillay, for permitting me to examine the urine of his patient and also to Dr. Krishnan, for permitting me to take the photomicrographs at the University Research Laboratory, Madras.

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S. India,  
March 31, 1952.

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#### RATOONING IN PADDY

RATOONING in paddy is not a common practice. In some places it is practised on a small scale.<sup>1,2</sup> At the Rice Experimental Area, Sabour, experiments were conducted to determine the height at which the crop should be harvested for better ratoon yield.

**Experimental Details.**—One of our Aus selection CH 10 was grown in six blocks in a plot

of fairly uniform fertility. Each of these blocks had four equal strips. When the crop came to maturity it was harvested on 8th October, when the stocks were still greenish at four different heights (treatments) in each block. These treatments were randomised and replicated six times.

Soon after the harvest the plot was irrigated and weeded and the stubbles were allowed to grow.

**Flowering and Maturity.**—Except the shoots which developed from the first node and those which came up from the underground nodes, all others in the various treatments came to flower in about two weeks' time from the date of harvest and in another 20 to 25 days they reached maturity. Flowering in shoots from the first and the underground nodes were irregular and the grain setting was poor.

The ratoon crop was harvested on 17th November. It may thus be seen that the ratoon crop takes only about 40 days to reach maturity as against the main crop which reaches maturity in about 120 days from the date of sowing.

**Yield from Various Treatments.**—Average yield from two years' data are given in Table I. These results were put to statistical test and were found to be significant.

TABLE I  
*Showing yield per acre of the various treatments*

Treatment	Average yield in lb. per acre	
	Main crop	Ratoon crop
A. Harvested close to the ground	1636.2	60.6
B. Harvested at about 6" above ground ( <i>i.e.</i> , the height at which the crop is ordinarily harvested)	1595.8	242.4
C. Harvested at half the height about 14" above ground	1616.0	505.0
D. The ears were picked up	1626.1	444.4

It may be seen from the above Table that the best ratoon yield of 505.0 lb. per acre—which is about 31 per cent. of the yield of the main crop—is obtained from treatment C, where the crop was harvested at half the height.

Lastly, it may be mentioned that except the viability of the seeds, other characters like plant height, panicle length, spikelet size, number of fertile shoots and grain setting were less pronounced in the ratoon crop.

Grateful thanks are due to Dr. R. H. Richha-  
ria for providing facilities for the work.

Botanical Section,  
Sabour,  
May 17, 1952.

A. B. SARAN.  
MANOJ PRASAD.

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#### OCCURRENCE OF *TILLETTIA TRANS-VAALENSIS* IN MYSORE

COLLECTIONS of smut fungi in the neighbourhood of Bangalore included a species of *Tilletia* on *Eragrostis tenuifolia* Hochst. which is a common grass in dry localities. The sori were ovaricolous appearing as elongated bodies protruding out of the enveloping glumes and covered with thick brownish-yellow membrane, which flaked away at maturity revealing dark-brown spore mass. The chlamydospores were reddish-brown under the microscope, 20-26  $\mu$  in diameter with a mean of 23  $\mu$ . The episore was thick with warty projections giving an echinulate appearance for the spores.

Comparative studies indicated that the *Tilletia* species under study is identical with *T. trans-vaalensis* described by Zundel from South Africa and has also been recorded in Benaras, India.<sup>1</sup> It may be of interest to note that very few species of *Tilletia* are known in South India as compared with the number known in North India. Only two species of *Tilletia* are known from Mysore including the one reported in the present study, the other species being *T. narayanaraoana* Mundkur & Thirum. on *Panicum trypheron* Schult.

Agricultural College, H. C. GOVINDU.  
Hebbal,  
Bangalore-6,  
June 12, 1952.

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#### CHROMOSOME NUMBERS IN THE GENUS *ZIZYPHUS*

THE chromosome numbers of *Zizyphus jujuba* (Indian jujube), *Z. sativa* (Chinese jujube) and *Z. sativa* as *vulgaris* have been previously reported to be  $2n = 24$ , 24 and 26 respectively.<sup>1</sup> Srinivasachar<sup>2</sup> has reported the haploid chromosome numbers of *Z. jujuba* and *Z. crenata* to be 20 and 10 respectively. Bowden<sup>3</sup> has reported the haploid chromosome number of both

*Z. jujuba*, Mill. and *Z. jujuba* Mill. var. *inermis* as 12. Investigations on the comparative morphology and cytology of a few members of this genus found in a small area of about a square mile round about Surat, revealed that they comprised plants of the following species with chromosome numbers mentioned against them:

I	<i>Z. rotundifolia</i> , Lamk.	..	..	..	n
II	<i>Z. crenata</i> , Mill.	..	..	..	36
III	<i>Z. mauritiana</i> , Lamk.:—plant No. 1	..	..	..	24
		2	..	..	24
		3	..	..	24
IV	<i>Z. jujuba</i> , Mill.:—	plant No. 1	..	..	24
	"	2	..	..	36
	"	3	..	..	36
	"	4	..	..	36
	"	5	..	..	48
	"	6	..	..	48
	"	7	..	..	48
	"	8	..	..	48
	"	9	..	..	48
	("seedless bor")	18	..	..	48

The chromosome numbers were counted during meiotic stages like diakinesis, first or second metaphase or anaphase in pollen mother-cells, either from temporary acetocarmine smears or from permanent smears stained with iodine-gentian-violet. The chromosomes in all of these were small. Secondary association of bivalents during first and second metaphase was observed in all the above plants but could not be analysed for want of sufficient number of clear metaphase plates. In *Z. rotundifolia*, meiosis was found to be normal resulting in regular tetrads. In the case of *Z. crenata*, lagging chromosomes were noticed during the first anaphase which subsequently formed themselves into micronuclei. The three individual trees of *Z. mauritiana* studied, though having the same number of chromosomes, were morphologically distinct from each other. Meiosis in each of them was normal. The ten plants studied in *Z. jujuba* belong to a regular polyploid series. One of them had  $n = 24$ , three had  $n = 36$  and six had  $n = 48$  chromosomes. Meiosis was normal in plants with  $n = 24$  or 36 chromosomes resulting in regular tetrads and fertile pollen grains. Only two plants with  $n = 48$  chromosomes exhibited normal meiosis. In the remaining four plants of this group, meiosis was normal only in some of the pollen mother-cells, while in the rest various meiotic irregularities like lagging chromosomes, formation of multivalents and unequal anaphasic separation were observed. In these, the pollen at the time of anther dehiscence was found to be mostly degenerated and polymorphic in

nature. Fruits borne on plant number 10 did not develop well-formed stones. Consequently, this tree was locally known as 'seedless bor'. All the ten plants of this species differed from one another in morphological characters. Detailed comparative morphological and cytological studies have been carried out in all the above plants and will be published elsewhere.

My grateful thanks are due to Sri. G. B. Patel for bringing to my notice the 'seedless bor' and to Dr. D. Chatterjee for the identification of the plants except *Z. rotundifolia*.

V. K. SRINIVASAN.

Agric. Experimental Station,  
Surat,  
March 24, 1952.

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**ASPERGILLUS FLAVUS LINK,  
A PARASITE OF THE DESERT  
LOCUST (*SCHISTOCERCA GREGARIA*  
FORSK.)**

*Aspergillus flavus* Link is a common air-borne mould and grows saprophytically on a wide variety of substrata, viz., grains and cereal products, leather goods, dairy products, home-canned fruits and vegetables, textiles, paper pulp, etc., and has been commonly isolated from soil, particularly in tropical and sub-tropical areas. Instances are, however, not uncommon where it has been found to be pathogenic, particularly on insects.

Dade and Wright<sup>1</sup> found it parasitic on the locust, *Locusta migratoria migratorioides* from Gold Coast, and Naumoff<sup>3</sup> and Lepesme<sup>2</sup> described its occurrence on Desert locust (*Schistocerca gregaria*) in Central Asia and North Africa. There seems, however, to be no record of its occurrence on the Desert locust in India so far.

Recently, a number of adult locusts (*Schistocerca gregaria*) in the cages at the Locust Laboratory of the Director, Locust Control in India, New Delhi, were found affected with *Aspergillus flavus* during September and October last. The affected insects developed yellowish grey patches on the sternum and thoracic regions, became very sluggish, and eventually stopped feeding. They died in 24 to 48 hours of the development of these symptoms.

Whitish and later greenish olive conidiophores of the fungus spread over the entire body.

During the course of preliminary experiments it was observed that the adults were more susceptible to disease than the hoppers. Mortality amongst the adults was more common during mid-September to October and gradually declined subsequently. Evidently the low temperatures towards the end of October and onwards did not favour the development of the disease.

The writer is highly indebted to Dr. H. S. Pruthi, Plant Protection Adviser to the Government of India, and Mr. C. B. Mathur, for the specimens and for kindly going through the manuscript.

A. P. MISRA

Directorate of Plant Protection,  
Government of India,  
New Delhi.  
March 31, 1952.

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**ANTHER AND POLLEN GRAINS OF  
ZANNICHELLIA PALUSTRIS L.**

WHILE a detailed investigation on the stamen of this plant awaits publication by the author, a few interesting points may be recorded here.

According to Campbell<sup>1</sup> the pollen grains contain two nuclei at maturity. He designates as tapeum about three layers of cells surrounding the sporogenous mass.

My observations reveal the presence of only a single layer of tapetal cells surrounding each of the four groups of sporogenous cells. The generative nucleus divides and the pollen grains attain the three-nucleate condition within the anther (Figs. 1 a, b). A tapetal periplasmoidium is formed in which the tapetal nuclei lie free amidst the pollen grains (Fig. 2). As there is practically no degeneration of microspore mother-cells, probably it is to these free tapetal nuclei that Campbell refers when he writes "not all the sporogenous cells give rise to spores; but a certain number are broken down and their free nuclei can be observed among the young spores."

A few twin anthers have been noticed. Each of these contains eight loculi and a common vascular trace (Fig. 3).

The present record for *Zannichellia* adds yet another member to the list of the Helobiales where, as a rule, the pollen grains are three-celled at shedding.

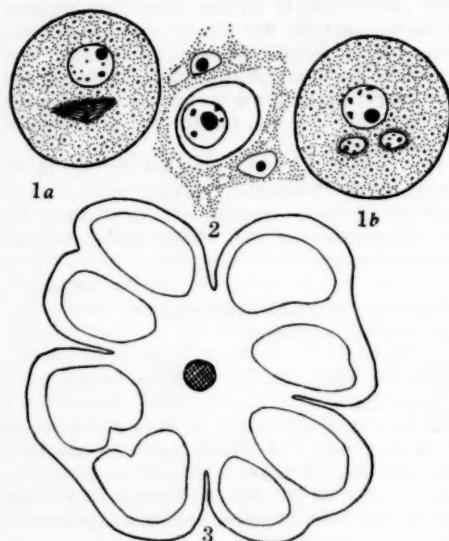


FIG. 1 Starch-filled pollen grains with the generative nucleus dividing (a), and the two male cells (b).  $\times 1270$ .

FIG. 2. Young pollen grain surrounded by periplasmoidium with tapetal nuclei lying free.  $\times 1270$ .

FIG. 3. T.S. of a twin anther showing eight loculi and a single vascular trace.  $\times 195$ .

I am indebted to Prof. P. Maheshwari for help in this investigation.

Dept. of Botany,  
University of Delhi,  
May 24, 1952.

C. S. VENKATESH.

1. Campbell, D. H., *Proc Calif. Acad. Sci.*, 1897, 1 (1), No. 3.

#### *SOLANUM MELONGENA VAR. BULSARENSIS VAR. NOVA, ARGIKAR*

A BRINJAL plant differing sharply from the varieties so far described in several of its morphological characters was noticed in a cultivator's field at Dharwar (Bombay State) in 1949. The progenies of this plant raised in 1950 and 1951 were found to breed true for all its undermentioned characters.

*The Plant.*—A semi-erect lustrous herb about 2' tall, neither woolly nor scurfy, entirely

spineless appearing in its young state like one of the *Nicotiana* spp. *Stem*.—Woody, round, smooth, glabrous, conspicuous and deep purple in colour bearing at every node mostly two or rarely three leaves, the cortex being comparatively softer, thicker and more leathery. *Leaves*.—Simple, large, green and thinner, about  $13'' \times 8''$  when borne at the base and about  $8'' \times 4\frac{1}{2}''$  when borne above, sessile, more or less elliptic, subentire and shallowly lobed, soft and shining, neither hairy nor tomentose. Midrib: spineless, completely purple on the dorsal side and up to over half its length on the ventral side, the veins being purplish on the dorsal side and greenish on the ventral side. *Flower*.—Either solitary or in clusters of two, three, four or more, 46–53 mm. in diameter having 5 oblong petals, the purple veins on the bluish spreading corolla being prominent. *Calyx*: distinct, having 5 leaf-like lustrous sepals, either green or with a development of purple pigmentation, the nerves being deep purple and prominent, more pronounced on the dorsal side, the venation of the sepals resembling that of the leaves; the calyx is abnormally persistent, the sepals being 40–70 mm. long and 15–30 mm. broad sometimes running along the entire length of the fruit or often opening out fully exhibiting the ventral surface of individual sepals. *Anthers*: 5, deep yellow. *Ovary*: superior with a long style. *The Berry*.—Glabrous, white, attractive, glossy and roundish, 70–90 mm. in diameter, rarely with very minor incisions appearing like a raw tomato fruit in shape having the colour of a white apple; rarely with faint purple shades, turning brown on maturity; borne either singly or in clusters of two, three or four fruits. *Epicarp*: thin, smooth and tough; *Mesocarp*: thick, the seeds being located nearer the central part of the fruit and not spread all over. The berry gets tough and hard as it attains maturity and on drying loses most of its moisture, the pericarp getting thinner and shrivelled, the epicarp turning dark brown, retaining its lustre. The fruit stalk: tough, abnormally short, 16–22 mm. in length holding the fruit semierect besides the stem.

There being a number of types of *Solanum melongena* no comparative description of any of them is cited here. According to Prof. Santa-pau, however, the plant described above appears to be nearest to the variety *inermis* of Dunal from which it differs mainly in the size of leaves, calyx, etc. Dunal, however, remarks that *inermis* is rather variable whereas this one

seems to be sufficiently distinct to make it a new variety, if not a new species.

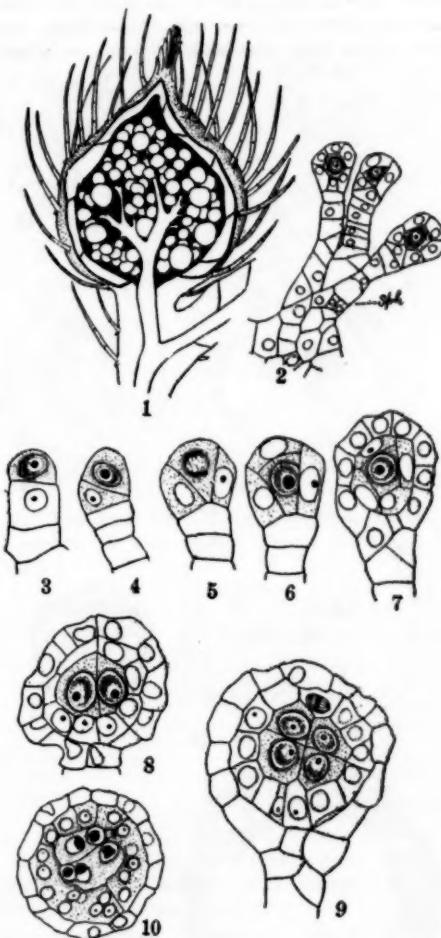
The chromosome number of this plant is yet to be determined. Crosses effected between this type and some Gujarat varieties failed to set.

Bombay Agricultural Dept., G. P. ARGIKAR.  
Bulsar, Surat,  
April 7, 1952.

#### APOGAMY IN SALVINIA

**APOGAMY** is known to occur in many ferns most of which, with the exception of *Marsilia Drummondii* studied by Strassburger,<sup>1</sup> belong to Leptosporangiatae especially Polypodiaceae. While investigating the causes of failure of the spore germination in three species of *Salvinia* locally available, viz., *S. auriculata* Aublt., *S. cucullata* Roxb., and *S. natans* Hoffm., it became necessary to investigate their cytology in detail which revealed the presence of apogamy in the genus. Due to apogamy the microspores are not normally formed in *S. auriculata*; whereas the megaspores are not healthy in *S. cucullata* as was observed by Deshpande.<sup>2</sup> In *S. natans* mega- and microspores are normally formed and are viable. The pattern of apogamy was closely followed in the microsporogenesis of *S. auriculata* and is as follows:

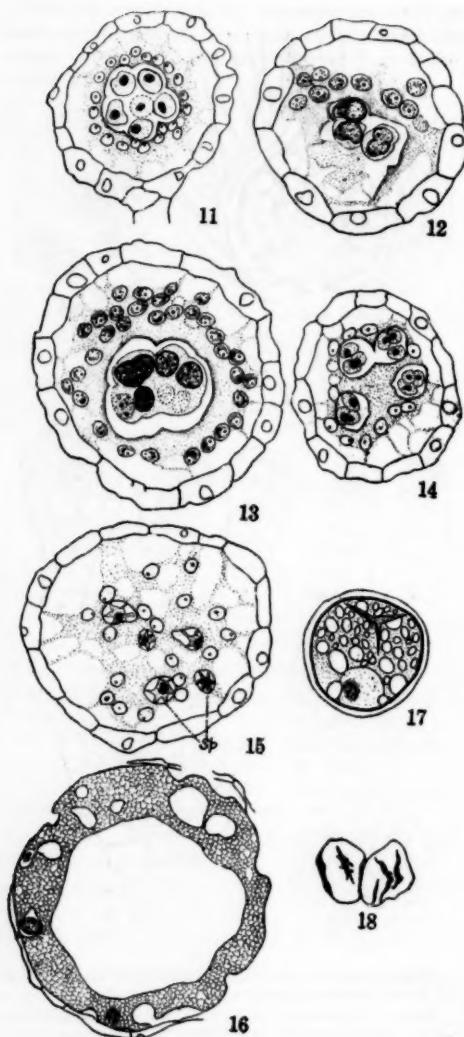
The sporangia in *Salvinia* appear basipetally in bunches of 2-4 each on short stalks, the so-called sporangiophores, radiating from the central receptacle (Figs. 1 and 2, sph). They develop as in a typical Leptosporangiatae fern, by forming a large tetrahedral archesporial initial (Figs. 3 and 7) surrounded by a layer of tepetum (Figs. 7 and 9). The four primary tapetal cells multiply and form an envelope round the primary sporogenous cells by the disorganization of their walls while the latter are undergoing reduction division (Figs. 9-11). The primary sporogenous cell in a microsporangium gives rise to two, four and eight spore mother-cells by successive mitoses (Figs. 8-11), but in the next division which is premeiotic, irregularities in the chromosomal cycle are introduced (Figs. 12 and 13). The eight spore mother-cells undergo incomplete nuclear division (Fig. 12) and form new eight or some times less spore mother-cells by the fusion of the adjacent nuclei (Figs. 12 and 13). The nuclei of the original eight spore mother-cells pass through prophase, metaphase and sometimes incomplete anaphase also, but the telophase neither follows nor is completed.



FIGS. 1-10. *S. auriculata* Aublt. showing deviations in the microsporogenesis leading to apogamy.

FIG. 1. A sporocarp in L. S. showing the arrangement of the microsporangia,  $\times 18$ . FIG. 2. A sporangiophore, sph, with three sporangia,  $\times 73$ . FIG. 3. A sporangia initial,  $\times 622$ . FIG. 4. A young sporangium with wall cell cut off,  $\times 622$ . FIGS. 5-6. The same with 2 and 3 wall cells cut off,  $\times 622$ . FIG. 7. A young sporangium with the primary sporogenous cell surrounded by 4 tapetal cells,  $\times 622$ . FIGS. 8 and 9. Young sporangia with 2 and 4 sporogenous cells  $\times 622$ . FIG. 10. Same with tapetal cells breaking down, their nuclei surrounding the spore mother cells,  $\times 370$ .

The result is, that the nuclei of the two incompletely divided cells fuse in pairs and form again eight large, diploid, oval, dumbbell- or club-shaped nuclei with incomplete cytoplasmic



FIGS. 11-18. *S. auriculata* Aublt. Massula and microspores.

FIG. 11. A sporangium showing 6 spore mother-cells separated out,  $\times 370$ . FIG. 12. Dividing spore mother cells fusing in pairs to form restitution nuclei.  $\times 475$ . Note the tapetal nuclei surrounding them. FIG. 13. Restitution nuclei formed,  $\times 475$ . FIG. 14. Restitution nuclei undergoing reduction division and forming spore tetrads,  $\times 370$ . FIG. 15. A young massula with five spores seen in it,  $\times 37$ . FIG. 16. An adult massula which is hollow,  $\times 37$ . FIG. 17. A fully formed spore,  $\times 622$ . FIG. 18. Two sterile spores,  $\times 622$ .

division (Figs. 12 and 13). The eight restitution nuclei so formed revert to the resting con-

dition for a while as in *Nephrodium hirtipes*,<sup>3</sup> *Aspidium filix-mas*,<sup>4</sup> *Aspidium remotum*,<sup>4</sup> *Polystichum tsumense*,<sup>5</sup> *Adiantum lunulatum*,<sup>6</sup> *Cyrtomium falcatum*,<sup>7</sup> etc. (Fig. 13). Later on these nuclei undergo meiosis (Fig. 14) and form 32, but generally less, 20-28 microspores in *S. auriculata*. Presumably here some of the spore mother-cells degenerate as in *Marsilia Drummondii* or form imperfect spores which have no capacity to germinate.

By the time the eight restitution nuclei are undergoing reduction division, the tapetal nuclei lose their walls (Figs. 11-14), their protoplasm forming a sort of pseudocellular frothy mass—the massula—in which ripe and unripe or abortive spores come to lie at the periphery by surface tension (Figs. 16, r.s. and u.s.). The process of massula formation is not the same in all species. There are many abortive spores in the massula of *S. cucullata* and *S. auriculata* but none in *S. natans*. Some of the previous workers<sup>8</sup> on the last-named species have reported 8 or 16 as the number of spore mother-cells in a microsporangium and also two different numbers of microspores, 32 and 64. The numbers of chromosomes reported also vary: 4 and 8 or 16. Judging from their figures and these facts, there seems to us a strong possibility of having some semi-sterile races of this species, namely, *S. natans*, which also may be reproducing apogamously. But this is a point which will need further investigation.

The megasporogenesis also shows irregularities which will be discussed later. In the meantime it may be stated here that the pattern of apogamy in *S. auriculata* described here agrees with that in *Nephrodium hirtipes*, *Aspidium remotum*, etc., in which the irregularities in the chromosomal cycle are introduced in the life-cycle of the plant at the eight-celled spore mother stage. To the best of our knowledge this is perhaps the second instance of apogamy known in any heterosporous fern, the first one being that of *Marsilia Drummondii* reported by Strassburger.<sup>1</sup> Further work is in progress.

Dept. of Botany,  
Inst. of Science,  
Bombay-1,  
November 25, 1951.

T. S. MAHABALE.  
JOYCE D'MELLO.

1. Strassburger, *Flora*, 1907, **97**, 123-188. 2. Deshpande, *J. Indian Bot.*, 1943, **22**, 49-84. 3. Steil, *Ann. Bot.*, 1919, **33**, 109-132. 4. Dopp, *Manual of Pteridology*, 1932, 271-274. 5. Patterson, *Biol. Gaz.*, 1942, **104**, 107-114. 6. Mehra, *Proc. Nat. Acad. Sci., India*, 1944, **14**, 189-204. 7. Manton, *Problems of Cytology and Evolution of the Pteridophyta*, 1950, 158-248. 8. Yasui, *Ann. Bot.*, 1911, **25**, 469-483; Heinricher, *Sitzs. der K. Akad. der Wiss.* 1882, **87**, 494.

## MICRODETERMINATION OF SELENIUM

A TURBIDO-COLORIMETRIC method for determination of very small amounts of selenium in natural materials such as soil, water and food-stuffs has been developed. It has been discovered that ascorbic acid reduces selenious and selenic acid and its salts in acid solution even in the cold and is much stronger than hydroxylamine used by Klein.<sup>1</sup> Another advantage is that ascorbic acid can be used directly even in the presence of iron, copper, nitric acid and other oxidising agents. The reduction is quantitative and the fine brown turbidity obtained is measured in a *Lumetron* photo-electric colorimeter with the 5-30  $\mu\mu$  green filter. The method is sensitive even in a concentration of 1  $\mu\text{g./ml.}$  of selenium in the test solution and a straight line curve is obtained upto 5  $\mu\text{g./ml.}$  selenium. Stronger solutions are suitably diluted. Repeated runnings on the same or equimolar solutions give reproducible results. Added selenium is quantitatively recovered. Accurately weighed dried material is digested with pure sulphuric acid. When the digest has liquefied, 2 drops of nitric acid are added and the digestion continued. If the digest has not clarified 1 or 2 drops of 60 per cent. perchloric acid are added and further digested. The incineration is complete in half an hour. Too strong boiling is avoided. When white fumes appear, the digest is cooled, diluted with water and made upto a known volume with filtration if necessary. 8 ml. aliquots are taken, warmed, 2 ml. ascorbic acid solution (20-40 mg./4 ml.) added, mixed, transferred to the comparison tube, transmission noted and the selenium value interpolated from the standard reference curve (Fig. 1). The standard curve is prepared by taking 8 ml. portions of standard solutions containing 1  $\mu\text{g.}$ , 2  $\mu\text{g.}$ , 3  $\mu\text{g.}$  and 5  $\mu\text{g.}$  selenium per ml. respectively and adding 2 ml. ascorbic acid solution (20 mg./1 ml.) in 10 per cent. sulphuric acid as above. The transmissions are plotted against concentrations. Selenium solution without ascorbic acid is taken at

100% transmission. Change in the pH of the test solution or increased ascorbic acid concentration does not interfere. For water sam-

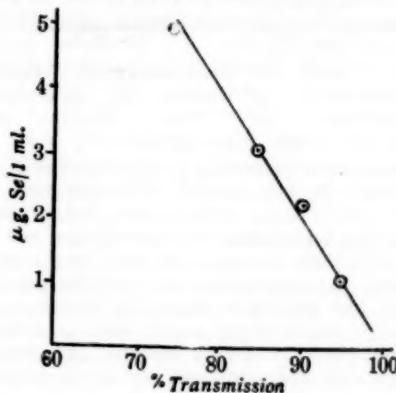


FIG. 1.

ples digestion with sulphuric acid alone is necessary. A few typical results are given in Table I.

TABLE I

Substance	Se content (mg/100 g. dry matter)			
	added	found	recovered	% recovery
<i>P. sativum</i>	..	..	1.2	..
<i>L. sativus</i>	..	..	22.5	..
<i>L. esculenta</i>	..	..	2.3	..
"	..	2.5	4.7	96.0

Details will be published elsewhere. We are indebted to the British Drug Houses Ltd., for the gift of sodium selenite.

Dept. of Medical Chemistry,  
Darbhanga Medical College,  
Laheriasarai,  
Bihar,  
May 10, 1952.

1. Klein, A. K., *J. Assoc. Official Agr. Chem.*, 1941, 24, 363.

## PROF. K. S. KRISHNAN

PROFESSOR K. S. KRISHNAN, F.R.S., Director, NPL, Delhi, has been nominated by the Government of India as India's delegate to the meetings of the Executive Committee and the Xth General Assembly of the URSI to be held at Sydney from August 8

to August 23, 1952. Dr. Krishnan will also attend the meetings of the Australian and New Zealand Association for the Advancement of Science to be held at Sydney from August 20 to August 27, 1952, as a representative of the Indian Science Congress Association.

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## REVIEWS

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**The Theory of Electromagnetic Waves—Symposium.** (Published by Interscience Publishers Inc., New York), 1951. Pp. viii + 393. Price \$6.50.

This book is practically a reprint of the papers published in the Journal, *Communications on Pure and Applied Mathematics*, which were originally contributed for a symposium held at the New York University in 1950. The interest in the classical theory of electro-magnetism, which had flagged in the earlier years of this century, was suddenly accentuated as a result of the demands of both industry and defence during the last war, and the great progress which took place in the use of high frequency radio waves. Entirely new methods of approach have been developed in the theory of diffraction of electromagnetic waves and of their reflection and propagation in heterogeneous media, particularly as a result on the work of Schwinger and his co-workers. It is only appropriate, therefore, that the book should begin with a paper by H. Levine and J. Schwinger on diffraction by an aperture in a conducting screen. The symposium covers a wide variety of topics—diffraction theory of Gaussian optics, wave propagation in non-homogeneous and stratified media, scattering and diffuse reflection of electromagnetic waves, microwaves, theory of wave-guides, diffraction of pulses and magneto-ionic triple splitting in the ionosphere.

It is impossible to refer in detail to the individual articles as they are highly specialised. The book is sure to lead to a large amount of new theoretical work on electromagnetic waves. Mathematicians in our country should greatly profit by a perusal of its contents, since a wide range of new problems has been thrown open as a result of some of these fundamental studies.

G. N. RAMACHANDRAN.

**Cosmology.** By H. Bondi. (Cambridge University Press), 1952. Pp. 179. Price 22 sh. 6 d.

Various theories have been put forward right through the ages regarding the nature and structure of the Universe, but these have been in the nature of speculations in the realm of philosophy. Cosmology as a branch of physics became important only in the present century,

mainly after the advent of the theory of relativity. The book under review gives an able summary of the different theories that have been proposed, presenting the salient points in each and also a critical appraisal of their contents.

Cosmology deals with the Universe as a whole and it is not surprising that all the theories deal with the nebulae as units and make no attempt to explain the detailed structure on a smaller scale. It was Einstein who first applied his general theory of relativity to the structure of the Universe and concluded that the only possible Universe is one which is finite (though unbounded) and absolutely static. Immediately after, de Sitter showed that Einstein's equations also led to a model which is continuously expanding. This remarkable result of de Sitter whose main interest at first lay in the fact that it proved that Einstein had been wrong, was corroborated by the later experimental studies of Hubble and others. Many other models were then proposed for the "Expanding Universe", associated with the names of Lemaître, Eddington and others. All these make use of a so-called cosmological principle, according to which the appearance of the Universe is the same for all observers at the same instant; but in all of them the average density of the Universe decreases continuously and in most of them, the Universe has a finite age. Very recently, however, Bondi (the author of this book) and Gold pointed out that a Universe could be constructed, which satisfies the "perfect" cosmological principle, according to which it should appear similar to all observers not only at one particular instant, but at all times. This is attained by a continuous creation of matter, the rate of which (a hydrogen atom per litre in  $10^9$  years) is, however, so small as not to contradict the law of conservation of mass to any appreciable extent. There is no restriction on the age of the Universe in this theory. The theory has also been put in relativistic terms by Hoyle. Naturally, the author believes that his "steady state theory agrees best with observation and has the simplest and most logical basis".

The book also contains brief sketches of the unorthodox theories of Milne (Kinematic Relativity), Eddington (Fundamental Theory)

Dirac and Jordan. The whole subject has been presented in a very balanced manner, with greater emphasis on the physical aspects rather than on pure mathematics. The book will be found to be a useful reference book by workers in the field. For the layman, it shows what extensive researches have been carried on in this abstruse field where observational facts are so meagre and the theories hover on the fringe between physics and philosophy.

G. N. RAMACHANDRAN.

**Safety Measures in the X-Ray and Radio-Active Laboratory.** National Bureau of Standards Handbooks. No. 47. *Recommendations of the International Commission on Radiological Protection and of the International Commission on Radiological Units*, 1950. Price \$ 0.15. No. 48. *Control and Removal of Radio-Active Contamination in Laboratories*. Price \$ 0.15. No. 49. *Recommendations for Waste Disposal of Phosphorus-32 and Iodine-131 for Medical Uses*. Price \$ 0.10. No. 50. *X-Ray Protection Design*. Price \$ 0.10. No. 51. *Radiological Monitoring Methods and Instruments*. \$ 0.15. Available from the Superintendent of Documents, Washington 25, D.C.

The use of radio-active materials and other sources of radiation in research and industry has increased to such an extent recently that the need for providing suitable protection from the ill-effects arising from them has become very urgent. The series of handbooks listed here which have been brought out by the National Bureau of Standards are, therefore, timely and contain the relevant information in a compact and readable form. They contain data about a wide variety of topics—the actual safe limits of radiation which is permissible in the laboratory, both for short duration as well as over extended periods; the instruments and methods by which the intensity of various types of radiation can be measured; details of the methods available for reducing radiation to within the safe limits; procedures for removing radio-active contamination both from the laboratory and from the dress and body of the workers; disposal of the radio-active isotopes used in biological and medical experiments.

The scope of the various handbooks is clear from their titles; and no special remarks are needed. However, it must be mentioned that the booklets are, one and all, particularly thorough and contain all the relevant instructions required in actual practice. Particularly in our country where work on these lines is rather limited, there is a tendency to under-

estimate the hazards arising from the presence of penetrating radiations and, therefore, one cannot too strongly recommend that every worker who is carrying out investigations using radio-active materials or X-rays should use these handbooks and take all the necessary precautions outlined in them.

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**Science German Course.** By C. W. Paget Moffatt. Revised by Joseph Horne and H. T. Betteridge. 5th Edition, 1952. Pp. vii + 325. Price 9 sh. 6 d.

The first part of the book dealing with grammar (Pages 1-98) has been re-written. Part II (Pages 99-110) contains simple readings for the beginner on general topics as "House and Garden", "The Laboratory", "Iron", etc. On pages 111-112 a list of the quoted periodicals is given. Part III (Pages 113-283) contains extracts from standard text-books and scientific journals grouped under "Physics", "Chemistry", "Mathematics", etc. This part has been brought up to date by inserting a great number of new reading passages from modern journals and deleting a number of extracts of the previous editions. The new revision is certainly a great improvement over the former editions. Especially the vocabulary (Pages 284-325) is a welcome addition.

In Part I, pains have been taken to render the student of German every help to find his way through the difficulties of idiomatic peculiarities. However, the following suggestions and corrections might be taken into consideration for future editions: it does not seem advisable (after a chapter on pronunciation) to begin with the Word Order. This matter can find its place after the treatment of the verb. The examples under § 18 where the subjunctive (indirect speech) comes in question, should be substituted by simple ones. The translation "er sagt, dass er gestern käme" for "He says that he came yesterday" is wrong. Correct is only "...dass er gestern gekommen sei" or "dass er gestern kam". Examples illustrating the various uses of the prepositions as found in previous editions have unfortunately been deleted. The treatment of the subjunctive was more systematic in the old editions. A paragraph on the use of tenses (as different from English) is missing.

A serious error has crept in on page 37. Content is *der Gehalt* the plural of which is *die Gehalte*. But *das Gehalt* with the plural *die Gehälter* means salary.

W. GRAEFE.

**Handbook of Earth-moving Machinery.** Published by Central Water and Power Commission, Government of India, 1951. Pp. 274. Price Rs. 8.

Nowadays earthen bunds are designed for much greater heights than formerly and the quantity of earth to be handled is enormous. If the work is to be done by ordinary manual labour, the labour force to be employed will be great and time required will also be considerable. The adoption of earth moving and earth handling machinery for earthen dams and channel excavation will no doubt be a great saving in time and labour.

The subject is divided into eight chapters. Chapter One deals with the machinery needed in dam construction. The equipment used in Hirakud Project, one of the big river valley projects is dealt with and the several problems met with there is very useful. Chapter Two deals with the project planning and principles governing the selection of earth-moving machinery. Chapter Three gives the details of earth handling and moving machinery and Chapter Four gives the details of prime movers required. The Chapter on maintenance and upkeep of the several earth-moving and earth-handling machinery is very instructive and every one who has something to do with the equipment should know it. The last two chapters deal with equipment of repair shops and training for the operators.

The book has been published at the most opportune moment and each Engineer and every technical library should possess the same.

K. SEETHARAMIAH.

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**The Terpenes.** Vol. III. By Sir John Simonsen. (Cambridge University Press, London), 1952. Pp. xi + 579. Price 50 sh. net.

The chemistry of terpenes is so very attractive a field of study that it can never fail to give surprises. There are at present more than 260 essential oils for which descriptions are available and the number of substances isolated and studied are so numerous that the appearance of the two volumes on terpenes in 1932 was an event of extreme importance. The reviewer had the good fortune to be allowed to read the manuscripts of the first two volumes as they were going to the Press and feels it a pleasure to write this review.

Sir John Simonsen has presented the subject-matter of the eleven chapters of the present volume with clarity, and reading through

these chapters is an intellectual pleasure. The volume is not a mere collection of facts but a clear exposition of the facts that have arisen during the course of investigations of the molecular marvels of the sesquiterpenes and diterpenes. The sesquiterpene section deals with forty-two individuals of known constitution and twenty of unknown constitution. The diterpene section deals with twenty-seven substances of known and three of unknown constitution. All this enormous volume of work is concisely and precisely dealt with in 480 pages. Then follows 41 pages of addenda to Volumes 1 and 2.

In recent times much attention has been devoted to the study of the higher boiling fractions of many essential oils containing the blue azulenic hydrocarbons. It is of extreme importance to remember that the conversion of linear sesquiterpenes to naphthalenes can follow, subject to the isoprene rule, three paths and the products terminated by two paths (cadalene and eudesmol types) alone have been found in nature so far. An analogous ring formation leads to nine possible azulenes. Eighty-seven members, including derivatives, of the azulene group have so far been recorded. The present volume deals with the chemistry of Guiazulene (S & Se) and vetivazulene, two of the best established members of the group.

In a short review it is not possible to cite all the outstanding merits of the volume. Sir John Simonsen has contributed much to our knowledge in this field by his outstanding classical researches and those who carefully read through this volume will discern the author's critical appreciation of the work of various contributors in the field. For those who want to begin the study of the subject and for those who take up work in the sesquiterpene and diterpene fields, there can be no better book for helpful guidance and ready reference. The printing and get-up of the book maintains the high traditions of the Cambridge University Press.

K. N. M.

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**Management and Conservation of Vegetation in Africa : A Symposium.** Bull. No. 41 of the Commonwealth Bureau of Pastures and Field Crops. Penglais, Aberystwyth, Wales, 1951. Price 10 sh. 6 d.

The present bulletin is one of the series planned for different continents by Dr. R. O. Whyte and the Director of the Commonwealth Forestry Bureau to indicate how much the

conservation of soil and the proper management of the land can lead to the conservation of vegetation and greater fertility of the soil. It is a pity that this should be the only bulletin to be issued of the planned series for when completed it would not only give us a survey of the measures so far adopted in different countries of the Commonwealth but would help one another. They would also open the eyes of the Governments to the urgent need and the benefits to be derived from vegetation surveys, mapping and the resultant economic and agricultural applications of them.

The Bulletin consists of seven articles covering the whole of British Africa and surprisingly no reference is to be found to the very valuable work done in the same direction in the French and Belgian Congo. An additional article on the work in these countries would have added to the value of the present bulletin and shown us what type of work is being carried out in countries outside the Commonwealth. Let us hope that some day this information is made available to us in a separate bulletin giving us information which is scattered in several articles and journals in French and Belgian.

Let us hope that this Bulletin will reveal to Indian scientists how much work lies ahead of us and that it is high time that concerted efforts are needed to collate all the existing information on the major problems that face us to-day like the "grazing and fodder resources". In an agricultural country like India, the problem of grassland improvement should have been taken up on an intensive basis long ago but we find ourselves instead on the threshold of it. This bulletin, therefore, should act as a stimulus and an eye-opener to the backward nature of our country in the matter of vegetation and soil conservation.

F. R. B.

**Literature Review on Fats and Oils, 1950.** By the Vanaspati Research Advisory Committee, C.S.I.R., and the Nutrition Advisory Committee, I.C.M.R. (Published by C.S.I.R., New Delhi), 1952. Pp. 28.

This is the second publication in the above series. The review gives a comprehensive summary of the results of important developments in the field of fats published in Indian and foreign journals during the year 1950. The subject has been divided for convenience in reading under appropriate headings, namely, production, trade, composition, synthesis, technology and processing, keeping quality, uses,

nutritive value and analysis of fats and fatty products. Considering the difficulty generally experienced in obtaining technical journals at one centre the reviewer has done a creditable job. A chapter on prices, and a contents page could have been added with advantage. The review should prove very useful to workers in the many fields in which fats and their derivatives play such an important role. The printing and arrangement of the matter have been done with considerable care. Early appearance of the next instalment in the series will be looked forward with eagerness.

N. N. DASTUR.

**Nuclear Data. Supplement 2 to N.B.S. Circular 499.** (U.S. Department of Commerce, Washington), 1952. Pp. 63. Price \$ 4.25.

During the last few years, the amount of information regarding atomic nuclei has become very vast and is also spread over in different journals all over the world. The National Bureau of Standards Supplement 1 and 2-Circular 499 on Nuclear Data is an attempt to collect all this information in a classified manner. Supplement 2 (compiled from information available upto January 1951) covers Supplement 1 for all practical purposes and the energy level diagram, etc., given in 1 are omitted and the reader is referred to the very comprehensive review on the subject by Hornyak, et al., "Energy level of light nuclei", *Rev. Mod. Phys.*, 1950, 22, 291. This Supplement contains for each isotope information regarding the total experimental neutron cross-section, the magnetic moment, spin and other facts relating to its radio-activity, if any. The method by which these quantities are measured is given in the next column and the references relating to any particular measurement are clearly indicated in the last column. The book is indispensable to any laboratory engaged in nuclear physics research.

R. RAMANNA.

#### Books Received

**Chemical Activities of Bacteria.** By Ernest F. Gale. (Oxford University Press), 1951. Pp. 213. Price Rs. 7-12-0.

**Genetics of Garden Plants.** By M. B. Crane and W. J. C. Lawrence. (M/s. Macmillan & Co.), 1952. Fourth Edition. Pp. xvii + 301. Price 20 sh.

**Hydraulic Research in the United States.** Edited by Helink Middleton & Sonya W. Matchett. (Miscellaneous Publication No. 201). (U.S. Department of Commerce), 1951. Pp. xi + 190. Price \$ 1.25.

## SCIENCE NOTES AND NEWS

### **Three Crops a Year**

Sri. A. B. Saran and Dr. R. H. Richharia, Agricultural Research Institute, Sabour, write as follows :

At the Rice Experimental Area, Sabour, two crops of paddy were followed up by one crop of wheat from the same plot. The first crop of paddy was sown broadcast in March and was harvested in June. After the harvest, the plot was prepared and the second crop of paddy was sown broadcast in early July, and harvested in October. The plot was prepared again and an early wheat was sown in November and harvested in March. The following yields per acre were obtained : (i) First crop Sona paddy, 1,074.2 lb. (ii) Second crop: Sona paddy, 1,246.4 lb. (iii) Third crop sown, Wheat No. Br. 319, 984.2 lb.

### **Vignan Pragathi**

A new monthly Research Information Bulletin in Hindi, entitled *Vignan Pragathi*, has been started by the Council of Scientific and Industrial Research, New Delhi. The first issue, released on August 15, 1952, contains articles on planning for cottage and small-scale industries and the National Physical Laboratory. The Notes and News Section gives outlines of processes for the preparation of castor seed oil through aqueous extraction, milk and curd from groundnut kernel, essential oil from costus roots, silage from leaves shed by trees during autumn, and borax-free enamel compositions. The patents section gives details of a new char-kha capable of spinning multiple yarns and the preparation of active carbon from groundnut husks. A glossary of technical terms used in the issue is given at the end of the number. (Annual Subscription Rs. 5. Single copy As. 8).

### **Indian Association for the Cultivation of Science**

Presenting the annual report of the Council for the year 1951-52, Prof. P. Ray, the Honorary Director, stated that this was the first report of the activities of the Association in its new buildings at Jadavpur. The process of shifting and setting up of equipment and apparatus in the new building naturally shortened the productive period of research work during the year. With the concerted efforts of all con-

cerned, however, the setting up of the laboratories was completed fairly quickly, and most of the laboratories were able to resume their activities before long.

The following are the office-bearers for 1952-53 : President : Dr. J. C. Ghosh. Vice-Presidents : Dr. D. M. Bose, Prof. M. N. Saha. Hon. Director : Prof. P. Ray (*Ex-Officio*).

### **Kalinga Prize, 1952**

The UNESCO has requested a nomination for the 1952 award of the Kalinga Prize for the popularisation of science from the Association of Indian Science Writers and has desired that it should be accompanied by at least 4 copies of the various works of the candidate, either copies of his books or reprints of his articles, if possible. Persons desiring AISW nomination are requested to send copies of their books and articles to the Secretary, Association of Indian Science Writers, c/o Science & Culture, 92, Upper Circular Road, Calcutta-9, by the end of August, 1952.

### **Daraprim—A New Anti-Malarial Drug**

"Daraprim", a new anti-malarial drug, has recently been put on the market by Messrs. Burroughs Wellcome & Co. It is 2 : 4-diamino-5-p-chlorophenyl-6-ethylpyrimidine, and is the most active of a large series of substituted 2 : 4-diamino-pyrimidines which have been synthesized and tested against laboratory infections of *Plasmodium gallinaceum* in chicks and *P. Berghei* in mice (Falco, et al., *Brit. J. Pharmacol.*, 1951, 6, 185). Although it is too early to assess the value of this drug, and there are as yet no reports on its action in *P. vivax* infections, its schizonticidal efficiency in *P. falciparum* and *P. malariae* infections appears to lie between that of paludrine and chloroquine, and it may prove to be a higher efficient malarial suppressant.

### **Award of Research Degree**

On the recommendation of a Board of Examiners consisting of Prof. R. Courant, Prof. A. Zygmund and Dr. Otto Szasz, the thesis entitled "Eigenfunctions of the Membrane Problem" by Sri. P. Sambasiva Rao, has been declared qualified for the Degree of Doctor of Science in Mathematical Physics of the Andhra University.